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The Implementation Planning Program is a collection of computer programs designed to assist the state governments in preparing their implement action plans for sulfur oxides and particulates. ~~This volume (I)~~ of the Implementation Planning Program ~~manual~~ describes the individual programs, their input data requirements and the output information generated. If also provides a detailed user's guide for the step-by-step preparation of inputs to the program. The individual programs are as follows: Source Data Management Program, Air Pollutant Concentration Program, Source contribution File Merger Program, Control Cost Program Control Cost File Update Program, Emission Standards Program, Emissions Standards File Update Program, and Regional Strategies Program.

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AIR QUALITY IMPLEMENTATION PLANNING PROGRAM

NOVEMBER 1970

Prepared for

Environmental Protection Agency
National Air Pollution Control Administration
Washington, D. C.

TRW.
SYSTEMS GROUP
WASHINGTON OPERATIONS

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PREFACE

In developing the Air Quality Implementation Planning Program described in this manual, TRW Systems Group has been guided by the intent of the Clean Air Act, as amended, as well as by extensive direct communication with National Air Pollution Control Administration personnel.

We are particularly indebted to Jack R. Farmer, Philip Bierbaum and Jerome B. Mersch, of the Division of Abatement, for their overall guidance in this project. The Office of Program Development provided the original impetus to the systems analysis approach to air pollution control through their sponsorship of the Regional Air Pollution Analysis Project (RAPA). The basic structure of the Air Quality Implementation Planning Program evolved as a part of the RAPA project.

A large number of TRW people participated in this project; those with the most direct involvement are listed below.

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1.0 INTRODUCTION

1.1 PURPOSE

The Implementation Planning Program is a collection of computer programs designed to assist the state governments in preparing their implementation plans for sulfur oxides and particulates. The regional air quality implementation process is based on the application of a set of stationary source emission controls in the form of emission standards. The many combinations of these standards result in a variety of alternative control strategies. Through application of computer simulation techniques, the Implementation Planning Program is used in selecting appropriate emission standards, evaluating the resulting air quality, and determining the costs associated with the various alternative control strategies.

The Implementation Planning Program Manual is written in two volumes. Volume I describes the individual programs, their input data requirements, and the output information generated. It also provides a detailed user's guide for the step-by-step preparation of inputs to the programs. Volume II presents complete program listings and flow charts along with the input and output for a sample test case. This second volume will assist the user in installing the Implementation Planning Program at his facility.

1.2 GENERAL BACKGROUND

The Clean Air Act, as amended (42 U.S.C 1857 et seg.), provides for an intergovernment system for the prevention and control of air pollution on a regional basis. To put this system into operation, the Department of Health, Education and Welfare (DHEW) must designate air quality control regions and issue air quality criteria and reports on control techniques. State governments then adopt ambient air quality standards and plans for implementation of the standards for the air quality control regions. The standards and plans are submitted to DHEW for review.

A summary of the legislative history behind the Act is provided in Appendix A, and a listing of the air quality control regions (as of September 1970) designated by their central cities is shown in Appendix B. Appendix C provides a listing of the National Air Pollution Control

Administration's Regional Offices which can be contacted for assistance in utilizing the Implementation Planning Program.

1.3 BASIC DEFINITIONS AND CONCEPTS

An implementation plan details all the steps to be taken for abatement and control of emissions from existing sources of pollutants within an air quality control region, to insure attainment of the ambient air quality standards within a reasonable time. It also includes measures to prevent urban and economic growth from adding to a region's air pollution problem. An implementation plan should include at least the following major elements: (1) information on existing source emissions and air quality data, (2) control plan for achieving ambient air quality standards, (3) emergency episode authority and procedures, (4) programs for monitoring air quality and emissions from the sources, (5) description of required legal authority, and (6) description of resources required by the plan.

The Implementation Planning Program described in this manual is designed to assist the user in developing the second of these elements for sulfur oxides and particulates.

An emission standard is a limitation placed on individual sources of a particular pollutant. Generally speaking, an implementation plan will specify different emission standards that are to be applied to different types of sources of each pollutant. These emission standards may be expressed in terms of mass of pollutant per unit gas volume or per unit time and will usually vary according to the size of the source.

An emission control strategy consists of selected emission standards covering all significant source types. The significant source types for particulates consist of fuel combustion, industrial processes, and solid waste disposal. For sulfur oxides, only fuel combustion and industrial processes are considered. Each political jurisdiction within an air quality control region may select a different emission control strategy.

When an emission control strategy is developed into legally enforceable requirements, it is then called a set of emission control regulations. The legally enforceable emission control regulations should be the final product of a comprehensive assessment of the nature and extent of a region's pollution.

The assessment leading to the development of emission control regulations includes a review of existing pollution levels, source types and their emissions, and available control techniques; and projections of the probable increase in source emissions due to urban and economic growth.

The process begins with the formulation of various emission control strategies. Based on the regional assessment, these strategies should then be evaluated by some systematic quantitative procedure to determine which, if any, are capable of attaining the desired ambient air quality. If more than one strategy should prove capable of achieving the desired air quality, the one which minimizes overall costs or which offers significant administrative advantages to the control agency would be selected. The technique of computer simulation modeling employed in the Implementation Planning Program offers such a systematic quantitative procedure. The program enables the user to systematically evaluate a wide range of emission control strategies (made up of emissions standards) as applied to the point sources of emission defined for the air quality control region.

The term point source of emission is defined here as any individual stationary source for which specific information is input to the program. A point source is usually specified on the basis of a single stack.

An area source includes the total emissions from all sources within a given square area which are either too small or too numerous to specify on an individual point-source basis. The total emissions for an area source are assumed to be uniformly distributed over the area. Area sources generally include small fuel combustion sources, on-site solid waste disposal, mobile sources, etc. Data on area sources are input into the program and are included in determining the ground level pollution concentration values. While emissions standards are not applied directly to area sources as is done with point sources, the program can include the influence of changes in the contributions of these sources (due to estimated effect of control regulations, urban growth, changes in fuel use patterns, Federal controls on mobile sources, etc.) through a mechanism of scale and projection factors. The user must supply these factors along with the emission standards in specifying an emission control strategy.

1.4 PROGRAM SUMMARY

The Implementation Planning Program contains a set of distinct programs which are designed to be run in sequence. The function and sequence of operation for each program are:

(1) Source Data Management Program (punched card input). This program creates, updates and lists the primary data file (defined as the Source File). The Source File will contain all sources of pollutants which may be considered by the Implementation Planning Program.

(2) Air Pollutant Concentration Program (punched card and Source File inputs). This program utilizes a diffusion model to transform source emission data into average, long-term, ground-level concentrations, and a statistical portion to determine corresponding frequency distributions for ground-level concentrations with short-term averaging times. The output is presented on printed tables and on magnetic tape, (defined as the Source Contribution File).

(3) Source Contribution File Merge Program (all Source Contribution Files created for a given region). This program is designed to merge the files produced by multiple (subregional) Air Pollutant Concentration Program runs into a single, regional file.

(4) Control Cost Program (punched card and Source File inputs). The purposes of this program are to simulate the application of alternative control devices available to each point source and to determine estimates of the total annual cost and efficiency of pollutant removal for each such application. The output is presented on printed tables and on magnetic tape, defined as the Control Cost File.

(5) Control Cost File Update Program (punched card and Control Cost File inputs). This program allows the user to correct or update information contained on an existing Control Cost File. Use of this program will, in general, reduce the number of control cost program runs required to produce a complete, error-free Control Cost File. Output is a corrected Control Cost File.

(6) Emission Standards Program (punched card and Control Cost File inputs). This program applies all candidate emission standards to the sources within each applicable political jurisdiction. The emission standard requirements are matched with the data on the Control Cost File such that the most cost effective device for each point source, under each standard, is produced. The output is presented on printed tables and on magnetic tape, defined as the Emission Standards File.

(7) Emissions Standards File Update Program (punched card and Emission Standards File inputs). This program is designed to update (i.e., change or add) emission standard application data contained on an existing Emission Standards File. As in (5), this program can eliminate costly reruns of the Emission Standards Program. Output is a corrected Emission Standards File.

(8) Regional Strategies Program (punched card, Source File, Emission Standards File and Source Contribution File inputs). This program applies specified emission control regulations and produces summary tables of the resulting emission reductions, control cost-effectiveness, and air quality values. The output from this program is the culmination of the Implementation Planning Program. The output becomes input for the determination of the Control Plan for achieving ambient air quality standards.

The subsequent chapters present the actual operating details of the individual programs. Chapters 3 through 6 describe the design and detailed data requirements for the Source Data Management Program, the Air Pollutant Concentration Segment [programs (2) and (3) above], the Control Cost Segment [programs (4) and (5)], and the Control Strategies Segment [programs (6), (7) and (8)], in that order. Chapter 7, a User's Guide, provides exact input and output data formats and specific operating instructions for the eight programs summarized above, which comprise the Implementation Planning Program. Chapter 8 summarizes all warning and error messages that could appear during the course of program operations. Chapter 9 gives the detailed specification of the computer system required for installation of the Implementation Planning Program. Chapter 10 and the appendices provides general reference information.

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2.0 IMPLEMENTATION PLANNING PROGRAM OVERVIEW

2.1 SCOPE OF PROGRAM

The computer programs contained in the Implementation Planning Program produce information that may be used to evaluate alternative emission control strategies. To correctly interpret this information, the user must be aware of the operational restrictions and input data requirements of the program. This chapter provides the user with an overview of the general program restrictions, the data that must be supplied to the program, and the operating sequence.

The applicability of the program is bounded by the following operational characteristics:

- The computer simulation takes into consideration two pollutants: sulfur dioxide (SO_2) and particulate matter.
- Although certain source data are expressed in short time spans (days or months), the computer simulation is concerned primarily with an annual time scale. The program will, however, produce short-term concentration values at a limited number of points within the region for comparison with short-term ambient air quality standards.
- The selection and evaluation of emission standards in an emission control strategy are done with respect to the political jurisdictions within an air quality control region. A maximum of ten political jurisdictions may be represented in the program.
- The emission standards evaluated by the program are restricted to stationary point sources of pollution. The point sources may include specific major fuel consumers, large-scale incinerators, open burning dumps, and industrial process sources. Although emission standards may not be applied directly to area sources, the effects of emission standards may be accounted for by input area source emission scaling factors. Area sources include the numerous, small-scale sources of pollution, both public and private.
- The effects on air quality due to region growth are determined through use of input point and area source emission rate projection factors.

The smallest computer configuration required to operate the program is the IBM 360/40 system. However, larger facilities (such as the 360/50 or 360/65) with appropriate peripheral equipment are compatible with the program design. A more detailed specification of the required computer system and the peripheral equipment is provided in Chapter 9.

2.2 PROGRAM INPUT INFORMATION

A wide variety of input information is required by the Implementation Planning Program. This section offers the user a brief overview of the classes of data, while Chapters 3, 4, 5 and 6 present specific data requirements for each segment of the program. The detailed input formats for each segment are given in Chapter 7.

2.2.1 Meteorological Data

The meteorological data required by the Implementation Planning Program are shown in Table 2-1. These data consist of those meteorological elements which have an important effect on the transport and dispersion of air pollutants.

TABLE 2-1

METEOROLOGICAL DATA ELEMENTS

- STABILITY WIND ROSE (WIND DIRECTION, WIND SPEED, STABILITY CLASS)
- MIXING HEIGHT
- AMBIENT TEMPERATURE
- AMBIENT PRESSURE

The stability wind rose data give the relative frequency of occurrence for each wind direction, wind speed class, and stability category combination as observed for the region and time period of interest. These data influence the transport process and the degree of dilution of the pollutant. The mixing height determines the amount of vertical mixing possible. The third and fourth elements influence the plume rise.

These four meteorological data inputs are available from the National Climatic Center (NCC) operated by the National Oceanic and Atmospheric Administration (NOAA) in Asheville, North Carolina. Here all meteorological data collected by Federal agencies are stored, tabulated, and summarized.

2.2.2 Air Quality Data

An air quality control region must have an air quality monitoring network to provide data for comparison with ambient air quality standards, analysis of emission control effects, and evaluation of emergency episode conditions. The data from this network required by the program are shown in Table 2-2.

TABLE 2-2

AIR QUALITY DATA ELEMENTS

- SAMPLING STATION LOCATION
- ANNUAL ARITHMETIC MEAN CONCENTRATION AT EACH STATION
- BACKGROUND POLLUTANT CONCENTRATION VALUES
- STANDARD GEOMETRIC DEVIATION (24-HOUR AVERAGE) AT EACH STATION

The first three elements are used in the validation process for the Air Pollutant Concentration Program. The last element is used in determining expected short-term pollutant concentration values.

2.2.3 Source Data

The source data must include information for all significant sources within the region.

Several types of air pollution sources are encountered in any given metropolitan area. Generally, these sources can be divided into four major categories and several subcategories. Table 2-3 is the breakdown used by the National Air Pollution Control Administration in presenting regional emission inventory data.

Pollution sources within these categories are further divided according to the two types: area sources and point sources. Area sources consist of numerous small sources of emission. Such sources include residential, commercial, governmental, institutional, and industrial fuel combustion operations, on-site solid waste disposal, and mobile sources. Point sources include major sources of emission, such as fuel users, incinerators, open burning dumps, and industrial process sources. In Table 2-3, principal sources in the first three categories are generally

TABLE 2-3

SOURCE EMISSION CATEGORIES

- FUEL COMBUSTION, STATIONARY SOURCES (Residential, Commercial, Industrial, Steam-Electric Power Plants)
- INDUSTRIAL PROCESSES
- SOLID WASTE DISPOSAL (Incineration, Open Burning)
- TRANSPORTATION, MOBILE SOURCES (Motor Vehicles, Aircraft, Railroads, Ships)

considered point sources. They form the basis for a classification scheme based on Standard Industrial Classification (SIC) categories. The fourth category is included in the area source inventory along with those sources in the first three categories, not specifically inventoried.

Input information on point and area sources, as required by the program, is given in Chapters 3 and 7. Table 2-4 shows the major data elements which must be specified for each point source; Table 2-5 depicts the major data elements for area sources.

TABLE 2-4

POINT SOURCE EMISSION INVENTORY DATA ELEMENTS

- IDENTIFICATION
- LOCATION
- SOURCE TYPE
- EMISSION QUANTITIES
- STACK INFORMATION
- EXISTING CONTROLS
- OPERATING SCHEDULES
- FUEL USAGE AND CHARACTERISTICS
- PROCESS RATE

TABLE 2-5

AREA SOURCE EMISSION INVENTORY DATA ELEMENTS

- LOCATION
- EMISSION QUANTITIES AND EFFECTIVE RELEASE HEIGHT
- AREA

2.2.4 Control Device and Regional Data

The types of control device and regional data required by the Implementation Planning Program are shown in Table 2-6. These data are utilized by the Control Cost Segment to determine control device application information. The control cost output information is then used in the Control Strategies Segment to determine the effectiveness and cost of alternate strategies.

TABLE 2-6

CONTROL DEVICE AND REGIONAL DATA

- DEVICE IDENTIFICATION
- DEVICE EFFICIENCY AND RATED LIFE
- DEVICE LABOR REQUIREMENTS
- DEVICE COSTS (PRICE, INSTALLATION, OPERATING)
- DEVICE APPLICABILITY
- LABOR COSTS
- ALTERNATE FUEL COSTS
- UTILITIES COSTS
- INTEREST RATE

2.2.5 Emissions Standards Data

Emissions standards which prohibit or restrict emissions of specific pollutants into the atmosphere have long been a major tool used by communities to combat air pollution. Many of the earlier emissions standards were designed to affect a reduction in local nuisance problems.

More recently, they have been adopted with a view toward achieving a general improvement in the quality of a community's air resources.

The specific emission standards to be used as candidates for a region's control strategy must be determined on the basis of many factors, including the industrial mix and local availability of different fuel types The Implementation Planning Program contains twenty-six different emission standards types for the user's selection. The data defining each selected emission standard may be changed when applied to different political jurisdictions, pollutant types and/or source categories. The twenty-six emission standard types include two general categories: (1) those which specify allowable emissions directly (e.g., process weight standard), and (2) those that imply an allowable emission rate (e.g., specification of a particular process or fuel type). Figure 2-1 illustrates the former type.

2.3 PROGRAM STRUCTURE

The Implementation Planning Program is composed of a Source Data Management Program and a series of distinct segments, as shown in Figure 2-2. The segments consist of the Air Pollutant Concentration Segment, the Control Cost Segment and the Control Strategies Segment. Each segment is itself composed of two or more computer programs.

The large numerals in Figure 2-2 indicate the sequence in which the programs are normally executed. The chapter and section references are given for the user's convenience. They indicate the sections in this manual which provide detailed information on operations within each segment. The User Validation operation, illustrated in the figure, is a purely manual procedure. It is included here to emphasize the importance of this step in the overall program application. If the Air Pollutant Concentration Program is not validated, reliable air quality output from either the Air Pollutant Concentration Segment or the Control Strategies Segment cannot be obtained. However, the user should note that, even if new air quality data are not obtained, the emission rate and cost-effectiveness summaries produced are invaluable aids in determining his control plan.

Summaries of the operational characteristics of each program are given in the following subsections.

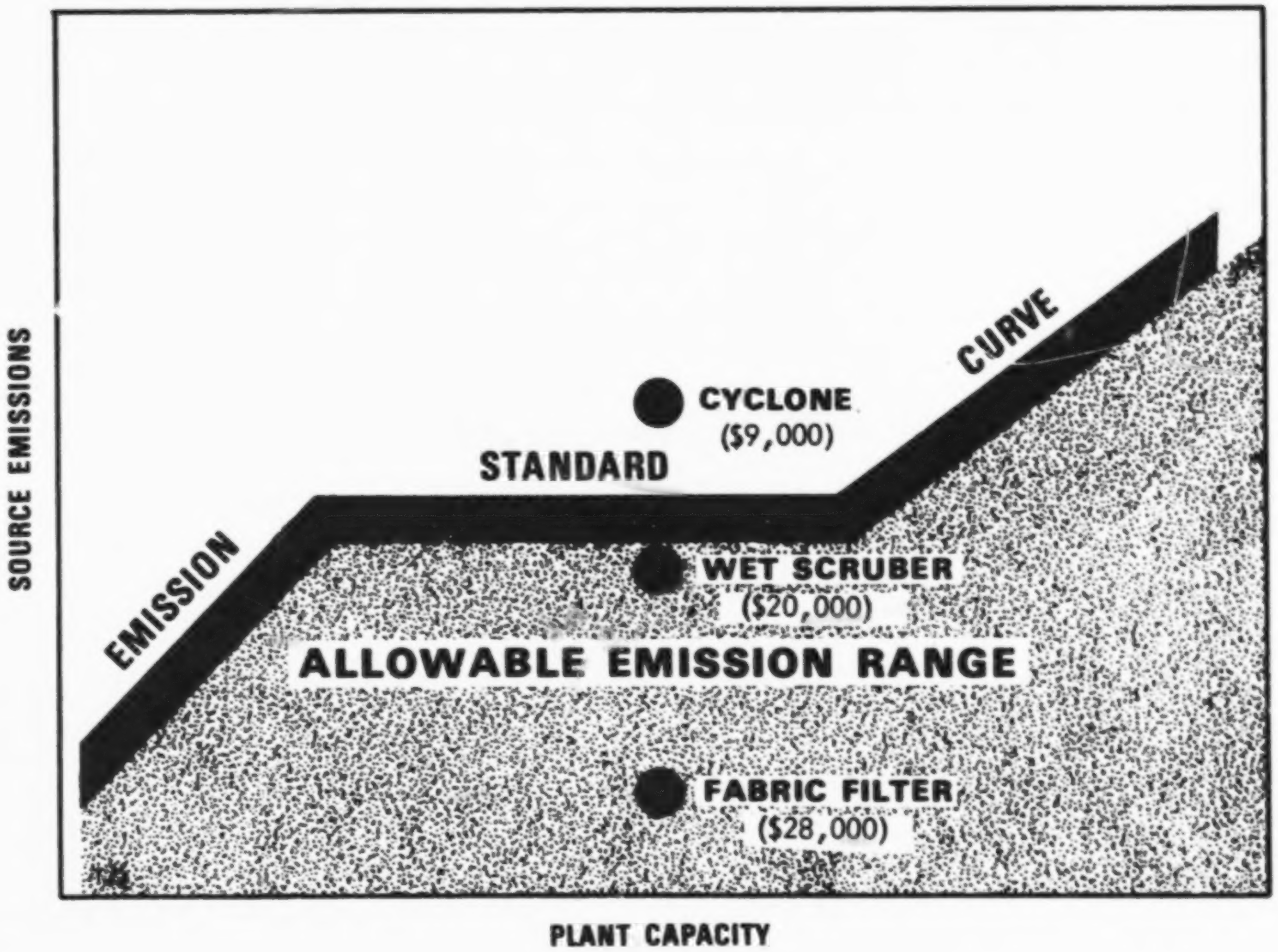

Figure 2-1. Typical Emission Standard Curve Relation to Control Device Application.

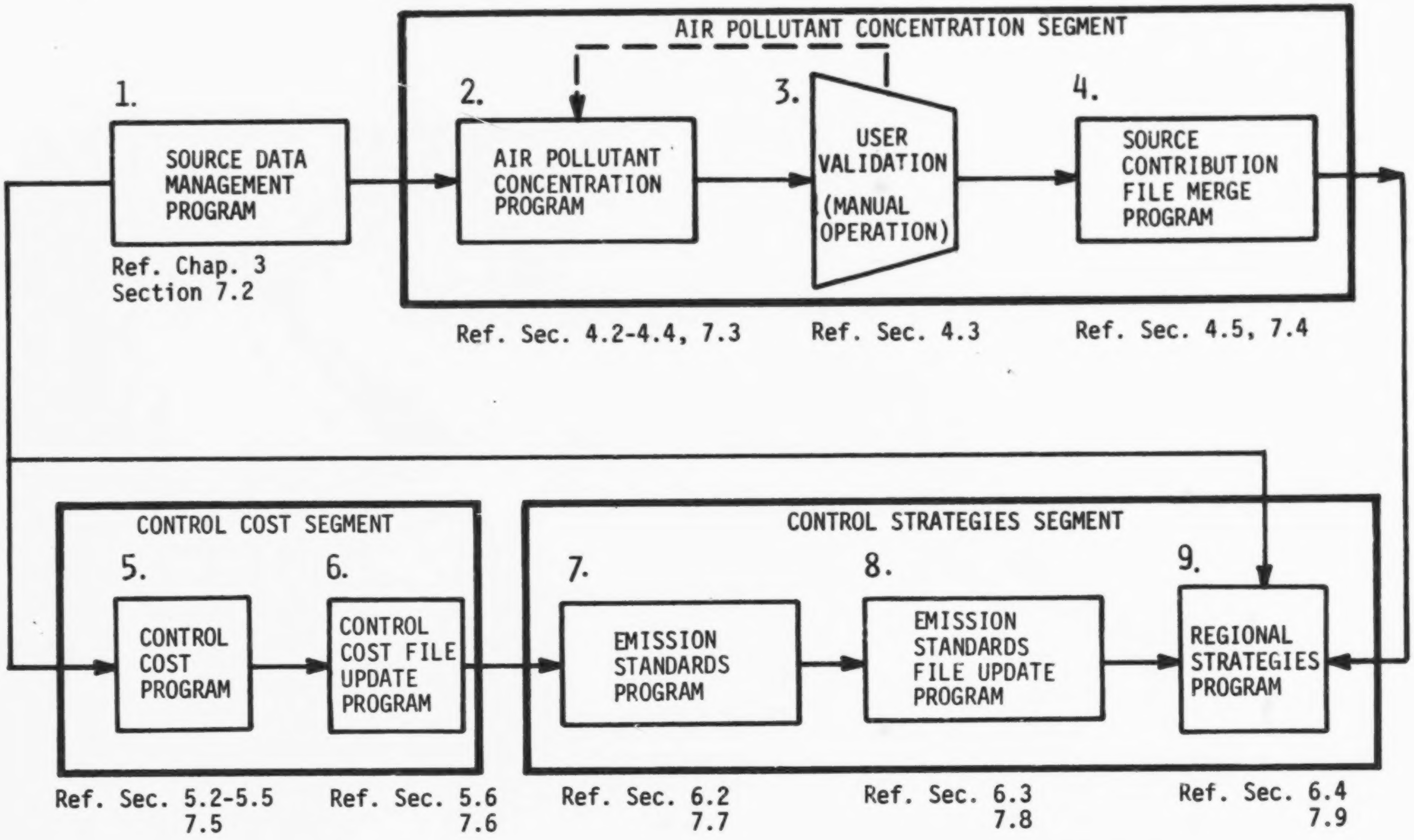
AIR POLLUTANT CONCENTRATION SEGMENT
1.
SOURCE DATA MANAGEMENT PROGRAM
Ref. Chap. 3 Section 7.2
2.
AIR POLLUTANT CONCENTRATION PROGRAM
Ref. Sec. 4.2-4.4, 7.3
3.
USER VALIDATION (MANUAL OPERATION)
Ref. Sec. 4.3
4.
SOURCE CONTRIBUTION FILE MERGE PROGRAM
Ref. Sec. 4.5, 7.4
CONTROL COST SEGMENT
5.
CONTROL COST PROGRAM
Ref. Sec. 5.2-5.5 7.5
6.
CONTROL COST FILE UPDATE PROGRAM
Ref. Sec. 5.6 7.6
CONTROL STRATEGIES SEGMENT
7.
EMISSION STANDARDS PROGRAM
Ref. Sec. 6.2 7.7
8.
EMISSION STANDARDS FILE UPDATE PROGRAM
Ref. Sec. 6.3 7.8
9.
REGIONAL STRATEGIES PROGRAM
Ref. Sec. 6.4 7.9

Figure 2-2. Implementation Planning Program Structure.

2.3.1 Source Data Management Program

The Source Data Management Program is used to create and maintain the permanent file (Source File) of point source and area source data. Each record on the Source File corresponds to an individual point or area source in the air quality control region. The Source File Management Program may be used to delete or change any record on the Source File or to add new records. The Source File provides direct input to the Air Pollutant Concentration Program, the Control Cost Program and the Regional Strategies Program.

Since the value range for the input data is quite large, only a limited error-check procedure is accomplished by the program. As a result, the user must carefully check the contents of the source data file for errors. This file must be free of errors and inconsistencies before proceeding with the application of other models.

2.3.2 Air Pollutant Concentration Segment

The major program in this segment, the Air Pollutant Concentration Program, is designed to estimate the spatial distribution of sulfur dioxide and particulate matter concentrations throughout the region. The pollutant concentration output from this program is derived from (1) an atmospheric diffusion model [Martin and Tikvart, 1968], which transforms the regional source emissions and meteorological data for a given annual (or other long-term) period into estimated ground-level arithmetic average pollutant concentration values, and (2) a statistical model [Larsen, 1969] which transforms the annual arithmetic mean concentration data (at a limited number of stations) into expected maximum and short-term concentration values for specified averaging times.

Validation of the program is accomplished through use of internally calculated least-squares regression lines. These lines relate the estimated arithmetic mean concentration values produced by the program to input measured arithmetic mean pollutant concentration values.

Program output consists of data tables and a punched card deck for the arithmetic mean pollutant concentration values and, if requested, data tables for the short-term pollutant concentration values. The punched card deck is designed for use with a plotter produce contour-line maps (isopleths) of the various concentration levels in the region. In addition to this output, the contribution from each source to each pollutant receptor defined within the region is output on magnetic tape (defined as the Source Contribution File) for use by the Regional Strategies Program.

The diffusion model and statistical calculations contained in the Air Pollutant Concentration Program are essentially the same as the corresponding parts of the Air Quality Display Model (AQDM) [February, 1970]. However, there has been some modification in the calibration procedures and the method of data input has been revised. The AQDM was designed to estimate only the spatial distribution of air quality levels in a region and was primarily intended for use by the States in determining the existing air quality levels and setting ambient air quality standards. The Implementation Planning Program is designed to assist the States in determining how they can achieve these ambient air quality standards through an emission control strategy.

The other program contained in the Air Pollutant Concentration Segment is the Source Contribution File Merge Program.

If more than one run of the Air Pollutant Concentration Program is required to provide the desired receptor density, the Source Contribution File Merge Program must be used to combine the several output files into a single file, as required by the Regional Strategies Program.

2.3.3 The Control Cost Segment

In general, each point source will have several control-measure options for reducing its pollutant emissions to meet each applied emission standard. The purposes of the Control Cost Program are to simulate the application of the alternative control devices available to each point source and to determine estimates of the total annual cost and efficiency of pollutant removal for each such application. The output consists of tables of control application data for each of the point sources defined in the Source File. The data generated by the program are output in printed tabular form and on magnetic tape (defined as the Control Cost File) for use by the Emissions Standards Program.

Figure 2-1 illustrates the results from a typical application of three control devices to a specific point source (e.g., an asphalt batching plant of a particular size). The total annual costs shown include the manufacturer's price, installation costs, annual capital charge, and the operation and maintenance costs. In computing these major expense items, the program takes into account factors such as equipment depreciation schedules, interest rates on capital, and cost or credit for pollutant disposal. The program also considers region-dependent costs to account for utilities costs, labor costs, etc.

Since a large number of input variables are involved, the output from the Control Cost Program should be verified by the user. Major errors usually require a rerun of the Control Cost Program. However, if errors or emissions are found which may be corrected by the user, a rerun of the Control Cost Program is not required. For such cases, the corrected data may be input to the existing file through the Control Cost File Update Program, the other program in the Control Cost Segment. This Program is used to change existing device-source records on the file and to list the contents of the file.

2.3.4 Control Strategies Segment

The function of the Control Strategies Segment is to apply a specified control strategy so that the least costly control technology that satisfies the appropriate emission standard is applied to each source. The segment provides sufficient output information to evaluate the regional impact of selected strategies from the standpoints of; (1) the types of sources affected by the strategy; (2) the degree to which these sources are affected in terms of control costs; (3) the resulting changes in pollutant emissions; and (4) the regionally aggregated values of control costs by source category, total reduction in pollutant emissions, changes in regional fuel-use patterns, and resulting air quality levels.

The Control Strategies Segment performs the simulation process through use of the Emissions Standards Program and the Regional Strategies Program. The user first selects all candidate emission standards (e.g., Figure 2-1) for consideration by the Emissions Standards Program. The program then compares the requirements of each standard with the data generated by the Control Cost Program. The program selects the most cost-effective device for each point source under each standard. In the example shown in Figure 2-1, the program would select the wet scrubber.

The data generated by the Emissions Standards Program are output in the form of printed tables for user review and on magnetic tape (defined as Emission Standards File) for use by the Regional Strategies Program. The table output illustrates the actual control measures selected for each source, the annual costs, and data on the degree to which emissions have been controlled. As in the case of the Control Cost File, the Emission Standards File should be checked for errors or omissions. If necessary, this file may be updated by the Emissions Standards File Update Program. This program is similar to the Source Data Management Program in that it has full capabilities of changing, adding or deleting records.

Finally, the user selects a set of standards to be applied (i.e., an emission control strategy) by the Regional Strategies Program. The program summarizes the existing, allowable and controlled emissions for the sources and generates new air quality data based on allowable or existing emission rates (whichever is less). Reduction of each area source emission rate is accomplished by user input scale factors. The Regional Strategies Program requires inputs from the Emission Standards File, the Source File (area source data), and the Source Contribution File.

Output from the Regional Strategies Program consists of regional and political jurisdictional summaries of regional costs, regional emissions, number of sources affected by a given standard, and figures of merit for each strategy (e.g., cost per ton of pollutant removed, cost per microgram or per cubic meter of reduced ground-level concentrations).

Since the programs comprising the Implementation Planning Program are interdependent, their efficient utilization requires the user to carefully plan his overall goals and program execution sequence. In general, the user should proceed in the following way:

(a) Create the Source File. Since this file is the basis of the entire Implementation Planning Program operation, it must be carefully checked for accuracy and completeness.

(b) Validate the Air Pollutant Concentration Program. It is wise to perform this function as soon as possible since inability to validate the program often leads to the discovery of source data errors. Once the program is validated, region-wide application of the Air Pollutant Concentration Program may be completed any time prior to the execution of the Regional Strategies Program. It is recommended, however, that the user proceed immediately with the execution of this program since the number of receptors specified for the entire region may require several different (subregional) runs. If multiple runs are required, the Source Contribution File Merge Program must be used to produce a single Source Contribution File.

(c) Determine the Control Cost Program Input Data. This includes a review of the pre-set control device data and the built-in (unalterable except by program modification) device application criteria. Since the device data are punched card input, the user should check the currency of the pre-sets and change them as necessary. (If new devices are required or if the applicability of existing devices is changed, a program modification is required.) If additional SIC and process codes (which identify the sources) are to be used, the device application for these codes (up to a maximum of five codes) may be input without a program change.

Finally, a set of region-dependent data must be input. These data consist of the device installation and maintenance cost data and data on the fossil fuels available in the region.

The Control Cost Program is then executed. Here again, errors resulting from bad source data may be encountered. If this happens, the Source File must be corrected and the Control Cost Program rerun. Depending on the error, the Air Pollutant Concentration Program may also have to be rerun.

(d) At this point, the user should select the candidate emission control strategy for each political jurisdiction defined in the region. This is done by setting up various combinations of those emissions standards that are available within the program. Since, for each pollutant, there are a maximum of 10 political jurisdictions and three source categories (fuel combustion, industrial process and solid waste disposal) for each of the 26 standards, there are over 700 possible strategies that may be applied. Obviously, then, the user must select a limited set to be tested. Once the set of strategies is determined, the composite emission standards must be input to the Emissions Standards Program, which is then executed. Once again, if errors occur and are traced to source data problems, both the Control Cost and Emission Standards Programs may have to be rerun (or their update program used).

(e) Now, the Regional Strategies Program may be executed. First, however, the area sources should be scaled to reflect emission controls compatible with the standards being applied. The area source scaling is based on predicted emission reductions resulting from factors such as regional fuel switches, mobile emissions control, space heating changes due to urban and economic growth, etc.

In the same way, projection factors (which adjust the future pattern of both point and area sources) are selected and may be input to determine a "projection" run based on a co-executed strategy run.

3.0 SOURCE DATA MANAGEMENT PROGRAM

3.1 INTRODUCTION

As is the case with any simulation technique, the results obtained can be no better than the input data. Computation of accurate air pollution related data is dependent on utilization of accurate and complete emission inventories and current data on control devices, fuel costs and their required parameters. The importance of adequate inputs to the successful operation of the Implementation Planning Program cannot be over emphasized. The input process for the Implementation Planning Program begins with the creation of the Source File.

The Source Data File provides permanent storage for the point and area source data required by the various Implementation Planning Program Segments. This file is maintained by a Common Business Oriented Language (COBOL) program which allows the user to create, update, and list the contents of the file.

3.2 INPUT INFORMATION

The point and area source data have specified input and storage units. The set of data stored in the Source File and the input and stored units are shown in Table 3-1.

A detailed description of each of these inputs is given in the following subsections. Descriptions of those inputs unique to each of the remaining Implementation Planning Program segments are given in subsequent chapters. The input card formats are given in Section 7.2.

3.2.1 Point Source Data

- Region Number. This three digit number identifies the air quality control region in which the source is located. A complete listing (as of September 1970) of air quality control regions and their designation numbers is presented in Appendix B.
- SIC Code. This four digit number, Standard Industrial Classification code, has been devised and published by the United States Department of Commerce to provide a uniform identification of a variety of industrial, commercial, and governmental operations. This code provides a convenient identification of point sources and is used in the assignment of control devices by the Control Cost Program.

TABLE 3-1

SOURCE FILE INPUT

Description	Editing Action
Point Source Data	
Region Number	Identification field no edit
SIC Code	
Site Number	
Process Code	
Descriptive Name	Non-blank
Location X (km)	Numeric, non-blank
Location Y (km)	Numeric, non-blank
Political Jurisdiction	Non-blank
Ownership	P,L,S,F or U
Source Type	B,P or S
SO_2 Emission (tons/day)	At least one or both must be non-blank
Particular Emission (tons/day)	
Operating Time (hrs/year)	Numeric
Shifts/Day	Numeric
SO_2 Control Efficiency (existing, %)	Numeric
Particular Control Efficiency (existing, %)	Numeric
Control Device ID (existing)	Alphanumeric
Rated Capacity (10^6BTU/hr)	Convert to BTU/hr
Coal Heat Content (10^6BTU/ton)	Convert to BTU/ton
Residual Oil Heat Content (10^3BTU/gal)	Convert to BTU/gal
Distillate Oil Heat Content (10^3BTU/gal)	Convert to BTU/gal
Gas Heat Content (BTU/cu.ft.)	Numeric
Coal Burned (tons/day)	Numeric
Residual Oil Burned (gal/day)	Numeric
Distillate Oil Burned (gal/day)	Numeric
Gas Burned (10^3 ft^3/day)	Convert to ft^3/day
Coal Sulfur Content (%)	Numeric
Residual Oil Sulfur Content (%)	Numeric
Distillate Oil Sulfur Content (%)	Numeric
Gas Sulfur Content (%)	Numeric

TABLE 3-1

SOURCE FILE INPUT (Continued)

Description	Editing Action
(Point Source Data)	
Coal Ash Content (%)	Numeric
Stack Height (ft)	Convert to meters
Stack Temp. (°F)	Convert to ^oK
Normalized Plume Rise (ft^2/sec)	Convert to square meters/sec
Maximum Process Rate (10^2 lb/hr)	Convert to lb/hr
Maximum Exhaust Gas Vol. (10^2ACFM)	Convert to ACFM
Stack Diameter (ft)	Convert to meters
Stack Velocity (ft/sec)	Convert to meters/sec
Use Factor	Numeric
Area Source Data	
Region Number SIC Code Site Number Process Code	Identification field no edit
Location X (km)	Numeric, non-blank
Location Y (km)	Numeric, non-blank
Area (km^2)	Numeric, non-blank
Political Jurisdiction	Numeric, non-blank
Effective Stack Height (ft)	Convert to meters
SO_2 Emission Rate (tons/day) Part. Emission Rate (tons/day)	At least one or both must be non-blank

A complete listing of the SIC Codes used by the program is presented in Chapter 5 (see Tables 5-2 and 5-3). The input SIC code must be included in this list. (For exceptions to this rule, see Subsection 5.2.3).

- Site Number. This element is an arbitrary three digit source identification assigned by the program user. Its function is to uniquely identify point sources that may have identical SIC and process code identifications.

- Process Code. Together with the SIC code, this two digit data element specifically identifies the process or operation causing the pollutant emission. A list of process codes and a more complete description of their use within the Implementation Planning Program are provided in Chapter 5 (see Table 5-3). This element and the three preceeding items make up the source identification field which must be complete and unique for each source within an air quality control region.

- Descriptive Name. An alphabetic name, of up to 23 characters may be supplied by the user for each point source. This item facilitates subsequent review and evaluation of the Source File itself and of other program outputs.

- Location X, Location Y. These coordinates specify the source location within the region. Although the origin of the coordinate system utilized is arbitrary, it is recommended that the Universal Transverse Mercator (UTM) system be adapted. The Universal Transverse Mercator system [Department of the Army, 1958 through 1967] is a convenient choice, since almost all United States Geological Survey maps utilize this system. In addition there is a growing body of information being collected in this system. The X and Y axes of the UTM system are oriented in the east and north directions, respectively. Because of the way in which the UTM system divides the globe into zones, care must be taken when the region of interest involves more than one zone (not a common occurrence, since the entire continental United States is covered by only 10 zones). The Army Map Service (AMS) has developed tables (TM5-241-2, Zone-to-Zone Transformation) to be used for conversion from one UTM zone to another. Assistance in using the UTM system may be obtained from the nearest NAPCA Regional Office (Appendix C). A local coordinate system may be used if desired, but the origin must be far enough to the southwest that all coordinates are positive. In either case, the coordinates must be input in kilometers. The coordinate system chosen for the source locations must also be used for subsequent receptor, and sampling station coordinate specification.

- Political Jurisdiction. All significant political jurisdiction within an air quality control region should be identified and assigned consecutive code numbers (up to 10). As the emission inventory is being compiled, the code number representing the jurisdiction in which each source is located must be included in the source record. In the context of implementation planning, a significant political jurisdiction is one which is empowered to adopt air pollution control regulations and for which a control strategy distinct from the remainder of the region may be desired.

- Ownership. Each point source must be characterized with respect to its ownership. All sources are divided into the following ownership categories; private (P), local government (L), state government (S), Federal Government (F) and utilities (U). This data element makes possible a more meaningful interpretation of the simulation modeling results.

- Source Type. The type of each point source must be identified according to the following classification. Fuel combustion sources should be coded (B), industrial process source (P), and emission sources due to solid waste disposal (S). This data element aids in the identification and evaluation of the program output records.

- SO_2 Emissions. The sulfur oxide emission rate (computed as sulfur dioxide) of each source must be supplied by the user in units of tons of pollutant emitted per day. This element and the particulate rate (next item) are the basic data obtained from the emission inventory and are used in every segment of the Implementation Planning Program (at least one of these elements must have a non zero input). The emission rates must represent the average daily rate, ton/day taken over an annual period. This rate is equal to the annual emission rate divided by 365.

- Particulate Emissions. The average daily rate of total particulate emissions, tons/day must be supplied in tons/day.

- Operating Time. The number of hours per year that each source conducts operations is a required data input. This data element makes possible the required conversion between daily and hourly source rate parameters such as emission rate and fuel use rates. These conversions are required in the Control Cost Segment and Control Strategies Segment and are further described in Chapters 5 and 6.

- Shifts. The average number of eight hour shifts worked daily must be determined and input for each emission source. This item is used (with Operating Time) in converting the time basis of various rates within the program. Shifts must be consistent with Operating Time as defined by: Operating Time = Shifts x 8 x 365. Thus the more accurate input should be used to determine the other input.

- SO_2 Control Efficiency. The removal efficiency of sulfur dioxide by an existing control measure must be input in terms of percentage. Only SO_2 removal produced by pollution control equipment as distinguished from process or production equipment should be considered under this item. It is very important that this item be input correctly as both the application of further pollution control (see Chapter 5) and of the emission limitations set by the emission standards (see Chapter 6) are dependent on this value. If more than one device is in use, the total device efficiency is used. This value must reflect the overall removal efficiency experienced by the source.

- Particulate Control Efficiency. The total efficiency of all existing pollution control devices designed to remove particulate matter must be input as the percentage removed. The notes relating to definition and importance of control efficiency presented in the previous paragraph also apply to this data element.

- Control Device (Existing). A three digit numeric code identifying the existing pollution control device, if any, may be input as a convenience to the user. A list of device identification codes used in the Implementation Planning Program is shown in Table 5-1. If the specific device in use at a particular installation cannot be identified in this listing, the user may devise his own coding system. If more than one device is in use at a location, the identification of the most efficient control device should be input.

- Boiler Rated Capacity. The design or maximum (whichever is greater) capacity of the fuel combustion unit, in terms of 10^6 BTU/hr, is a required input for each fuel combustion source. This item is based on the design or maximum operating characteristics of the source and not on the average operating conditions. It is important that this item be obtained for each combustion source as the application of several emission standards in the Control Strategies Segment depend on this value.

- Coal Heat Content. This value must be input for each combustion source which burns coal. It should represent the average heat content of coal burned (units of 10^6 BTU/ton) at the particular source over an annual period. Along with the other parameters defining the existing fuel-use pattern, this item is required to determine the cost and effectiveness of various fuel switching measures (see Chapter 5).

- Residual Oil Heat Content. This element is used in the same way as the previous item and must be input if residual fuel oil is consumed at a source. Input units are 10^3 BTU/gallon.

- Distillate Oil Heat Content. If the fuel combustion source uses distillate fuel oil, this item must be input. The use and importance of this value within the program are the same as for Coal Heat Content. Input units are 10^3 BTU/gallon.

- Gas Heat Content. The heat content, in BTU/ft^3, must be input if any gaseous fuel is burned. Generally, this will represent the heat content of the natural gas available at the source.

- Coal Burned. This value represents the average daily consumption of coal, over an annual period, and must be entered for each combustion source if coal is burned (units of tons/day). If the fuel is being used for space heat, the daily quantity used will vary considerably throughout the year. The average of the daily usages is required. (Daily usage is equal to annual usage divided by 365). If this element is non-zero for a source then the Coal Heat Content, Coal Sulfur Content, and Coal Ash Content must be supplied by the user. With the exception of the input Ash Content these notes also apply to usage of the following three fuel types.

- Residual Oil Burned. This element, in units of gallons per day, must be input for each combustion source which uses residual oil.

- Distillate Oil Burned. This element, in the units of gallons per day, must be input for each fuel combustion source which uses distillate oil.

- Gas Burned. The average daily use of gaseous fuel must be input for each fuel combustion source (input units 10^3 cubic feet/day).

- Coal Sulfur Content. The average percent sulfur by weight must be input if coal is used as fuel at a source.

- Residual Oil Sulfur Content. If residual fuel oil is burned at a source, this element must be input, as a percentage by weight.

- Distillate Oil Sulfur Content. This parameter, as defined in the previous paragraph, must be input if distillate fuel oil is used.

- Gas Sulfur Content. This element must be filled in if gaseous fuel is utilized. The percent sulfur by weight is generally very small or zero.

- Coal Ash Content. This value represents the non-combustible fraction of coal expressed as a percent by weight. It must be supplied if coal is burned at a particular source.

- Stack Height. The height of the stack, in feet above ground level, must be supplied for every point source.

- Stack Temperature. The temperature of the exhaust stream at the stack exit must be input for each source. This value should represent average operating conditions and be expressed in units of degrees Fahrenheit.

- Normalized Plume Rise. If the stack velocity or diameter is not available for a particular source, or if the user wishes to employ a plume rise equation different from the Holland equation defined by Equation (11) in Chapter 4, then an estimate of the plume rise may be input. Input units are ft^2/second.

- Maximum Process Rate. This value must be input for all industrial process or solid waste disposal sources. It represents maximum design conditions rather than actual operating practices. The input units are 10^2 pounds per hour. This item should include the weights of all solid or liquid raw materials entering the process.

- Maximum Exhaust Gas Volume. Again the design or maximum (whichever is greater) conditions should be used in specifying this parameter. This value must be input for every point source. The input units are 10^2 actual ft^3/minute (ACFM) and should represent the exhaust volume released at the operating temperature and pressure of the exhaust stack.

- Stack Diameter. The inside physical diameter of the stack exit (in feet) should be supplied by the user for each source. If this parameter and the following parameter are not known the normalized plume rise can be used as mentioned above. If the normalized plume rise, stack diameter and velocity are input as zero, the physical stack height will be used as the effective stack height.

- Stack Velocity. This item should be input for each source. This is the average velocity of the exhaust gas stream in feet per second.

- Use Factor. This item must be supplied for all sources. It is calculated by dividing the design or maximum (whichever is greater) source capacity (e.g., maximum process rate) by the source usage (e.g., actual process rate). This factor is necessary to properly apply emission standards based on potential emission rates.

3.2.2 Area Source Data

Area emission sources are comprised of a large number of small pollutant emission sources (both mobile and stationary) which describe the emission density over a specified geographical area. The physical data and identification relating to these small sources is not sufficient to permit creation of the detailed information that is available for the large point sources. Accordingly, only a limited set of emission inventory data is required for these source types.

- Identification. A unique, numerical identification must be supplied for each area source. This identification is comprised of 12 digits in the following order:

  Region Identification as described for point sources - first three digits.

  9999 - digits 4 through 7. This number is used throughout the program to identify area sources.

  Site identification arbitrarily assigned by the user - digits 8 through 11

  0 - digit 12. This is required to maintain identification compatibility between point and area sources.

- Location X
- Location Y

  The point source description of these parameters also applies here. The location supplied for each area source, in kilometer, must represent the lower lefthand (southwest) corner of the square grid for which emissions are being reported.

- Area. The physical size in square kilometers must be supplied for all area sources included in the emissions inventory.

- Political Jurisdiction. The same political jurisdiction divisions defined for the point sources must be utilized to assign each area source to a political jurisdiction. If an area for which emissions are computed extends into two or more political jurisdictions, the emissions should be proportionately divided between the several jurisdictions and a separate area source record created, assigning the appropriate emissions to each political jurisdiction. Each of the records so created should list identical locations and areas. This procedure will allow the preparation of proper summary tables by political jurisdiction.

- Effective Stack Height. An effective height of emission must be estimated for each area source. This estimate is usually based on knowledge of the average height and plume rise characteristics of pollution released in the area. The units for the item are feet.

- SO_2 Emission Rate. The total aggregated sulfur dioxide emission rates of all sources located within the area and not included in the emission inventory as point sources must be input by the user for each area source. These emissions must be reported as average annual daily emissions (tons/day). The tons/day value is equal to annual emission rate divided by 365.

- Particulate Emission Rate. This value, computed and reported on the same basis as SO_2 emissions (tons/day), must be supplied with each source record.

3.3 PROGRAM OPERATION

The source file maintenance program utilizes card input data to create a sequentially stored data file. In addition, this program allows the user to update and/or list the contents of a previously created file. Operational characteristics of the program consist of the following items:

- File Creation - The card input data is sorted, according to source ID card number, edited, and a master file is created. The edit function consists of checking the input data for required entry form errors (numeric or alphabetic fields, correct code letters, missing data, etc.) and conversion to storage units. The storage units are used by all calling programs. The edit function for each input parameter is shown in Table 3-1. If input errors are found, a message identifying the error is printed and the source record is not loaded.

- File Update - The update input data is sorted, edited, and merged with the master file. The update edit function is the same as in the creation of the file. The user may delete records, update data or add new records.

- File Listing - A formatted listing of the data, in the order contained in the file, may be obtained by executing the data management program with a list card.

Although each of these management program functions are separate job steps, file creation and file listing or file update and file listing combinations may be obtained within a single run. Detailed operating instructions are given in Section 7.2.

3.4 PROGRAM OUTPUT

The program output, obtained through the File listing operation described above, consists of all data shown in Table 3-1 after conversion to storage units. An example file listing is shown in Subsection 7.2.

4.0 AIR POLLUTANT CONCENTRATION SEGMENT

4.1 PURPOSE

The Air Pollutant Concentration Segment consists of an Air Pollutant Concentration Program, which produces sulfur dioxide and particulate matter concentration values, and a Source Contribution File Merge Program which merges output files from multiple (sub-regional) Air Pollutant Concentration Program runs. The uses and operating procedures for the Source Contribution File Merge Program are given in Section 4.5. The remaining sections in this chapter describe the Air Pollutant Concentration Program.

The purpose of the Air Pollutant Concentration Program is to provide printed output of existing air quality data and to provide source contribution data to the Regional Strategies Program. Through a mathematical simulation of the atmospheric diffusion process [Martin and Tikvart, 1968], the program determines the estimated arithmetic average pollutant concentrations at ground level over an annual period. The resulting spatial distribution of average concentration values is output in both tabular and punched-card form. In addition, the spatial distributions of average concentration values resulting from each source are output on magnetic tape (defined as the Source Contribution File). This file is utilized by the Regional Strategies Program to determine air quality data after application of emission standards. To provide estimates of short term pollutant values, a statistical model [Larsen, 1969] is used to transform the average concentration data from a limited number of receptor points into maximum and various percentile concentration values.

The Air Pollutant Concentration Program has three basic modes of operation which differ according to the way in which they utilize the simulation to perform various functions. Each run of the program will consist of some combination of these modes.

(a) A Calibration Mode designed to calibrate the estimated arithmetic mean pollutant concentration output from the diffusion model with available measured air quality data input by the user. The procedure involves determination of least-squares regression lines which relate the measured and estimated concentration values for each pollutant. The regression lines are then used in the diffusion model during the receptor concentration mode of operation.

(b) A Receptor Concentration Mode which uses the calibrated diffusion model to calculate the total calibrated arithmetic mean pollutant concentration values at selected receptor points throughout the region. A set of values may be calculated for each of the two pollutant types. This data is then output in tabular form. If requested, the data will also be output in punched card form for use in contour plot applications. This segment also creates the Source Contribution File which is required by the Regional Strategies Program (Section 6.4). The Source Contribution File contains the uncalibrated pollutant contributions from each source to each receptor, the calibration constants and the background concentration values. In conjunction with this mode of operation, the following mode may be specified.

(c) An Analysis Data Output Mode in which the mean concentration data is used to produce the following types of data tables for each pollutant considered.

(1) Excess Table - Lists those receptors which exceed an input regional ambient air quality standard and provides information on the point and area source contributions to each such receptor.

(2) Statistical Table - Lists maximum and three selected percentile concentration values for 12 selected receptors. The table may be repeated for each of five selected averaging times.

(3) Source Contribution Table - Lists the individual source contributions to the five highest-concentration receptors or, if desired, to five selected receptors.

4.2 INPUT INFORMATION

Program input data is obtained from both the Source File (see Chapter 3.0) and from punched cards. The types of input data required for each of the operational modes of the program are described in the following sections. The detailed data input methods for the Source File and the Air Pollutant Concentration Program are given in Sections 7.2 and 7.3, respectively.

4.2.1 Input Common to All Modes

The source file data and certain punched card data are required for execution of each of the basic program operational modes. In particular, this common data consists of:

(a) Source Data. Both area and point source data are supplied by the Source File. For point sources, the location, average emission rate (tons/day) for each pollutant, and the stack parameters (or a normalized plume rise value) are provided. The stack parameters, which include physical stack height, stack exit diameter, effluent exit velocity and effluent temperature, are used to obtain the effective height of release (i.e., the height at which the plume becomes horizontal) for use in the diffusion calculations. For each area source (assumed to be square in shape) the Source File provides the area, average emission rate (tons/day) for each pollutant, and an assumed effective height of release.

The remaining common data is input in punched card form.

(b) Stability Wind Rose Data. This data gives the relative frequency of occurrence for each combination of wind direction, wind speed class, and stability category as observed for the region and time period of interest. Although the wind direction is a continuous variable, for purposes of computation it is specified in sectors corresponding to 16-point compass headings, with sectors 1 through 16 corresponding to winds blowing from the directions N, NNE, NE, ..., NW, and NNW, respectively. Similarly, for calculation purposes, the model employs 5 representative values of stability class and 6 representative wind speeds. Since there are 5 stability classes, 16 wind directions, and 6 wind speed classes in the model, the complete set of stability wind rose data consists of 480 frequency values. When summed over all categories, the relative frequency is 1.0. The program utilizes a single set of stability wind rose data for the region.

(c) Mixing Height. The mixing height defines the layer of the atmosphere above the surface through which the pollutant is mixed. Since this height has large seasonal, daily, and diurnal variations it is practical to account for only major changes. The program uses a single input value and modifies it according to the stability class. If the mixing-height value is not available, it may be estimated from Holzworth's [1964] estimates of the monthly mean afternoon mixing heights in the contiguous United States.

(d) Ambient Temperature and Pressure. Ambient temperature (°K) and pressure (mb) values are input for use in calculating the effective stack height.

(e) Pollutant Decay Factors. To account for the decay of pollutants in the atmosphere, each pollutant may be assigned a half-life value (hrs). For SO_2, a half-life on the order of three hours is appropriate.

(f) Background Concentration. For each pollutant, a value for the background concentration ($\mu g/m^3$)* may be specified. The background concentration is applied uniformly throughout the region and is assumed to be independent of the sources within the region.

4.2.2 Input for Calibration Mode

In addition to the common data described above, the following punched card input data is required for calibration of the diffusion model.

Measured Air Quality Data. For each pollutant for which the diffusion model is to be calibrated, data from 3 to 100 measuring stations may be specified. The data includes station locations (which may differ for each pollutant type) and measured arithmetic mean concentration levels ($\mu g/m^3$). Station locations are specified with respect to the same origin used to specify the emission source locations.

4.2.3 Input for Receptor Concentration Mode

In addition to the common data, the following punched card input data is required for execution of the Receptor Concentration Mode of operation.

(a) Basic Receptor Data. Up to 225 regularly spaced receptors may be specified, together with 50 individually located receptors. These receptor locations are used for both pollutants (particulate and sulfur oxides). The regularly spaced receptors are defined by intersections in a grid pattern having equidistant vertical and horizontal spacing. The grid pattern is determined by the location of its southwest corner (with respect to the source origin), the number of rows and columns of receptors, and the distance between adjacent rows and columns.

For identification purposes, the receptors are numbered consecutively, starting with the southwest corner of the grid pattern, running through the columns, and ending with the individually located receptors. This basic set of receptor identification numbers is used to specify particular receptors for output purposes.

(b) Correlation Data. The regression coefficients obtained from the Calibration Mode (or from any applicable validation procedure) must be input. One set of coefficients is required for each pollutant.

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*$\mu g/m^3$ = micrograms per cubic meter.

4.2.4 Input for Analysis Data Output Mode

In addition to the input data required by the Receptor Concentration Mode, this operational mode requires special card inputs (which vary with the form of the output desired).

For the Excess Table:

Ambient Air Quality Standards. For each pollutant considered, the arithmetic mean concentration value ($\mu g/m^3$) not to be exceeded must be specified.

For the Statistical Table:

(a) Output Receptor Selection. For each pollutant, a maximum of 12 output receptor locations may be selected from the basic receptor set (defined in Section 4.2.3).

(b) Standard Geometric Deviation. For each of the selected output receptors, a standard geometric deviation value for a 24-hour averaging time must be input for each pollutant (the program automatically converts this value to the desired output averaging time). For output receptors located at measuring sites, the standard geometric deviation values will be obtained from the measuring station data. For output receptors not located at measuring sites, the standard geometric deviations must be interpolated from nearby measuring station values.

(c) Averaging Time. Up to 5 different averaging times for each pollutant type may be specified. A set of data will be output for each averaging time selected.

(d) Output Percentile Values. Up to three percentile values may be specified for each pollutant.

For the Source Contribution Table (Selected Receptors Option):

Output Receptor Selection. For each pollutant, five receptors (selected from the basic receptor set) may be specified for source contribution output.

For the Source Contribution Table (Maximum Concentrations Option):

No Special Data Requirements. For each pollutant, the program will utilize the 5 receptors of highest concentration.

4.3 PROGRAM OPERATION

This section presents a description of the operations and data manipulations involved in operation of the program.

4.3.1 Calibration Procedure

The calibration procedure, repeated for each pollutant, begins with the use of the diffusion model to calculate the concentration values at each of the input measuring sites. Since the calculated concentration values at the measuring sites do not include a background concentration, (as the measured values do) direct comparison between the two is not desirable. To enable a direct comparison, (i.e., correlation) to be made, the program will subtract the background concentration from each of the measured values. For descriptive purposes, the measured minus background concentrations are defined here as "observed concentrations."

A least-square regression line of observed concentration values on calculated values is then obtained. This procedure is used to determine the straight line which best fits the plot of calculated versus observed concentrations. The scatter diagram shown in Figure 4-1 illustrates the procedure. Each point plotted represents both the calculated and observed concentration values at a given receptor. For each pollutant then, there is a regression line:

$$\hat{\chi}_p = A_p + B_p \chi_p, \qquad (1)$$

where

$\hat{\chi}_p$ = observed concentration (measured minus background) of pollutant p

χ_p = calculated concentration of pollutant p

A_p = y-axis (observed concentration) intercept of best-fit line for pollutant p data

B_p = slope of best-fit line for pollutant p data.

If the regression line adequately describes the relationship between the observed and calculated concentration values, it may then be applied to the region in general (within the range of calculated values used to determine the regression line). The Air Pollutant Concentration program output would thus be adjusted at each receptor point according to the equation:

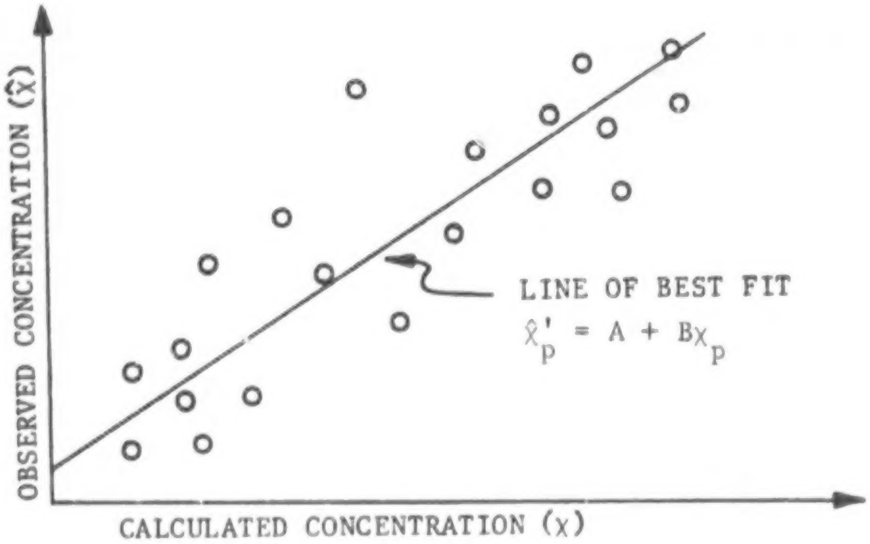

Figure 4-1. Scatter Diagram.

$$\chi'_p = A_p + B_p\chi_p + (\chi_{BG})_p \tag{2}$$

where

χ'_p = total calibrated pollutant concentration for pollutant p

$(\chi_{BG})_p$ = input background concentration for pollutant p

To determine if the regression lines are adequate, the coefficient of correlation, a measure of data-scatter about the regression line, is calculated and compared with the maximum theoretical value that could arise due to chance.* The maximum theoretical value is determined for a 5% confidence level (that is, there are fewer than 5 chances in 100 that a coefficient of correlation as high as this value would arise due to random sampling variation). If the coefficient of correlation is greater than the theoretical value, it will be considered statistically significant and the regression line will be used to adjust the calculated values. If, on the other hand, the coefficient of correlation is less than the theoretical value (i.e., not statistically significant) the regression line will not be used. A poor correlation warns the user that the input data (e.g., emission data, meteorological data, or observed concentration data) should be revised. If after all input data is thoroughly reviewed and corrected an

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[*] For a general discussion of these concepts, see Fisher [1954].

acceptable correlation is still unattainable, the model assumptions should be reviewed by a meteorologist familiar with such modeling techniques.

If only a limited number of measured concentration values are available (fewer than 20 for most regions), or if their locations cover only a small portion of the region, calibration of the model may not be meaningful. However, it would still be of interest to check the model output with available measured data. In this way at least a partial check of the model's adequacy can be made. So that such checks may be performed and the regression results analyzed prior to region-wide application, the program has the options shown in Table 4-1.

TABLE 4-1

CALIBRATION OPTIONS

Option	Calibration Application
0	The user must input the regression constants A_p and B_p (and the appropriate background concentration values $(\chi_{BG})_p$). The program will apply the resulting regression line equations to the calculated concentration values prior to output.
1	The program will determine the regression lines and, if correlation is statistically significant, will adjust calculated concentration values accordingly. If the correlation is poor, the calculated concentrations will be output without adjustment and a message printed to indicate that correlation was not statistically significant. In either case, the calculated regression constants and correlation coefficients are output.
2	The program will determine the regression lines and correlation coefficients and stop.

Since model calibration is usually a trial-and-error process involving refinement of the input data, Option 2 is most economical. Once good correlation has been achieved, Option 0 can be used. (Note, however, that if input background values are used when determining the coefficients A_p and B_p in Option 2, then the same background input values must be used in Option 0.)

4.3.2 Diffusion Model Description

The atmospheric diffusion model is based upon a diffusion model developed by Martin and Tikvart [1968]. The basic output of the model is in the form of calculated long term average pollutant concentrations at ground level. Concentrations for short periods (1 hour, 8 hours, etc.) are estimated by means of a statistical technique developed by Larsen [1969] and are discussed in Section 4.3.3.

The Martin-Tikvart model calculates concentrations downwind from a set of point and area sources on the basis of the Pasquill [1962] point source formulation. A description of the process follows:

The stack in Figure 4-2 represents a typical elevated point source. The coordinate system for this source has its origin at ground level at the base of the stack (i.e., directly below the effective point of emission). The x-axis extends horizontally in the mean wind direction. The y-axis is horizontal in the cross-wind (and cross-plume) direction. The z-axis is vertical.

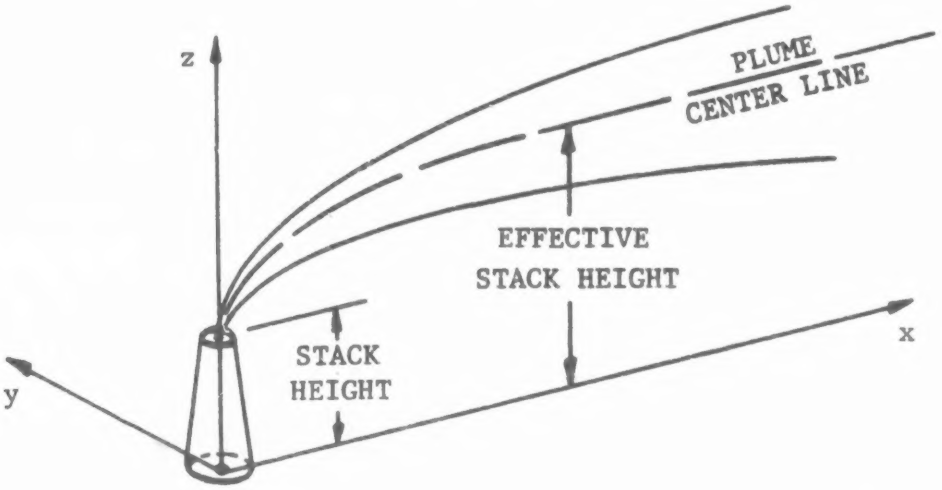

Figure 4-2. Source Coordinate System for Diffusion Model.

The "effective stack height" (or effective height of emission release) is the height at which the plume center line becomes horizontal.

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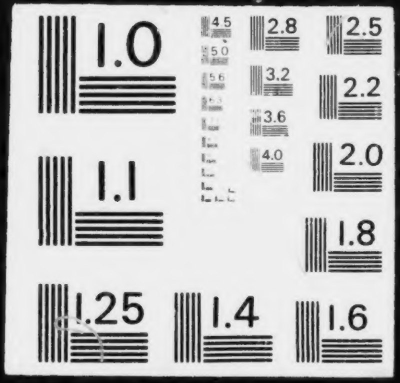
1.0
4.5
5.0
5.6
6.3
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

The effective stack height is the sum of the physical stack height and an incremental factor related to the buoyancy and vertical momentum of the effluent.

The concentration, χ, at a position (x,y,z) for pollutants emitted at (0,0,h) is given by

$$\chi(x,y,z;\ h) = \frac{10^6 Q}{2\pi\sigma_y\sigma_z u}\ \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right]\left\{\exp\left[-\frac{1}{2}\left(\frac{z-h}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+h}{\sigma_z}\right)^2\right]\right\} \qquad (3)$$

where:

$\chi(x,y,z;\ h)$ = pollutant concentration, micrograms/meter^3, at point x,y,z for an effective stack height h.

Q = emission rate, grams/sec.

u = mean wind speed, meters/sec.

σ_y,σ_z = standard deviation of the plume concentration distribution in the cross-plume and vertical directions, meters. (σ_y and σ_z are given as functions of downwind distance and atmospheric stability, Gifford [1961]).

Equation (3) is based upon several assumptions, including:

(a) Total reflection of the plume takes place at the earth's surface.

(b) The time-averaged plume exhibits a Gaussian distribution of concentrations in the cross-plume and vertical dimensions. The measures of the spread in both directions (the standard deviations) are considered to be a function of downwind distance and atmospheric stability only.

(c) The plume is a steady-state phenomenon resulting from a constant, continuous emission source, and none of the effluent "disappears" (by chemical change or by absorption on the ground surface, for example). Thus, an area integration of Equation (3) in any plane perpendicular to the plume center line is constant, regardless of the downwind distance. As described later in this section, an exponential decay factor may be applied to account for pollutant removal.

Ground-level concentration estimates are obtained by setting z = 0 in Equation (3), resulting in

$$\chi\ (x,y,z;\ h) = \frac{10^6 Q}{\sigma_y \pi \sigma_z u}\ \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right] \exp\left[-\frac{1}{2}\left(\frac{h}{\sigma_z}\right)^2\right] \qquad (4)$$

For a source which emits at a constant rate from hour to hour and day to day, Equation (4) can be modified to yield estimates of long-term (annual or seasonal) average concentrations if applicable stability wind rose data are available. A wind rose tabulates the frequency of occurrence for each wind direction and wind speed class for the time period under consideration. A stability wind rose contains the same information, but it is further divided according to atmospheric stability classes.

Although the change in wind direction is a continuous function over the long-term period, for computation purposes discrete wind directions are specified with respect to a 16-point compass, corresponding to 22.5-degree sectors. For seasonal or longer periods it is often assumed that all wind directions within a given 22.5-degree sector occur with equal frequency. Thus, the effluent could be assumed to be uniformly distributed in the horizontal within the sector. However, this assumption would result in discontinuities in calculated concentrations at sector boundaries. A more reasonable distribution is obtained by using a linear interpolation between sector centerlines. Thus, the concentration at a given receptor location is composed of proportional contributions from both the sector containing the receptor and from the nearest adjacent sector. The linear interpolation term is given by (c-y)/c, where y is the crosswind distance between the receptor and the sector centerline, and c is the sector width at the receptor location. This concept is illustrated in Figure 4-3. Note that a SSW wind affects the receptor to the NNE of the source.

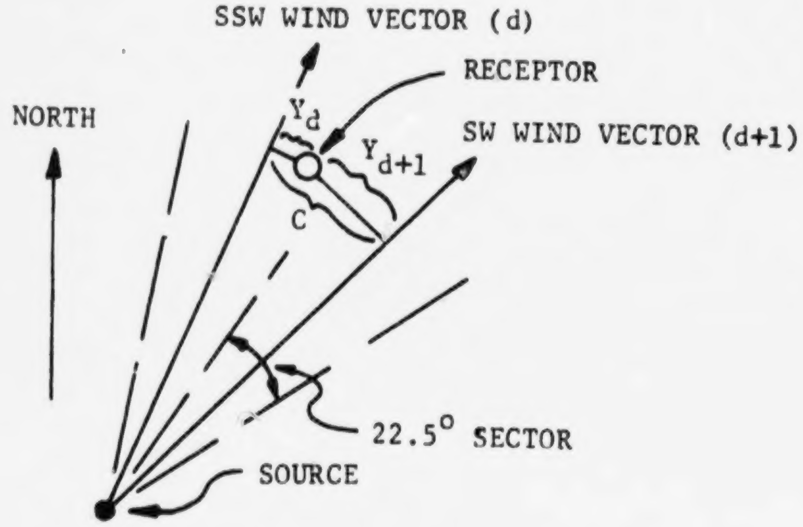

Figure 4-3. Interpolation of Wind Directions.

Use of the linear crosswind distribution requires that the form of Equation (4) be changed to reflect a univariate Gaussian distribution:

$$\chi = \frac{2Q \cdot 10^6 (c-y) \; / \; c}{\sigma_z u \sqrt{2\pi} \; (2\pi x/16)} \; \exp \left[- \frac{1}{2} \left(\frac{h}{\sigma_z} \right)^2 \right] \tag{5}$$

When an elevated stable layer occurs locally, the estimated pollutant concentrations are calculated with the assumption that all the effluent remains within the mixing layer height L, where L is defined as the vertical distance from the ground to the base of the stable layer. For the model calculations, σ_z is considered to increase in the downwind direction until it reaches a distance x_L at which $\sigma_z = 0.47L$. Up to this distance, the Gaussian vertical distribution is assumed, and Equation (5) is appropriate. At distance x_L the trapping effect of the elevated stable layer begins to be effective, and uniform mixing below the base of the stable layer is assumed to occur at downwind distance $2x_L$. For distances $x \geq 2x_L$, the average concentration is calculated with the assumption that the plume is uniformly mixed in the vertical:

$$\chi = \frac{10^6 Q(c-y)/c}{Lu(2\pi x/16)} \tag{6}$$

For distances between x_L and $2x_L$, χ is determined by a linear interpolation between Equation (5), evaluated at x_L, and Equation (6), evaluated at $2x_L$.

For a specific receptor (r) and source (s) configuration, an estimate of χ_{rs} for each pollutant is obtained by choosing a representative wind speed for each wind speed class and solving the appropriate equation for every wind speed and stability class appropriate for the time period in the geographical area of interest. The average concentration, χ_{rs}, is obtained by summing all concentrations and weighting each one according to its frequency for the particular wind direction, wind speed class, and stability class. The expression for average concentration for a given pollutant is:

$$\chi_{rs} = \sum_{d=1}^{16} \sum_{n=1}^{6} \sum_{m=1}^{5} F_{dnm} \; \chi_{dnm} \tag{7}$$

where:

F_{dnm} = normalized frequency during the period of interest for wind direction interval d, wind speed class n, and stability class m

χ_{dnm} = average ground-level concentration calculated from Equation (5) or (6) as appropriate.

For each of the 16 wind direction intervals, wind speed is defined in six categories and stability class in five categories. Thus a three-dimensional array of 480 categories is established. However, only a few of these wind directions result in non-zero contributions for specific source-receptor pairs. Thus the computation time is reduced significantly. Vertical variations in wind speed and wind direction are not accounted for in the present model.

The representative speeds associated with the six climatological wind speed categories (0-3, 4-6, 7-10, 11-16, 17-21 and >21 knots), are given by the five mid-interval values of 0.67, 2.46, 4.47, 6.93 and 9.61 meters per second, and by 12.52 meters per second (25.5 knots) for the >21 knots category.

The five stability categories (S = 1, 2, 3, 4 and 5, in order of increasing atmospheric stability) are defined on the basis of the criteria stated by Turner [1964]. Stability in the lowest part of the atmosphere is determined primarily by the net radiation and local wind speed.

Turner's classification is based upon ground-level meteorological observations only (surface wind speed, cloud cover, ceiling), supplemented by solar elevation data (latitude, time of day, and time of year); thus the stability estimates can be obtained for any Weather Bureau station at which continuous observations have been made.

The total concentration at a specific receptor r, $\overline{\chi}_r$, for a given pollutant is

$$\overline{\chi}_r = \sum_s \chi_{rs}, \qquad (8)$$

where

χ_{rs} = the average estimated concentration at receptor r from source s, as given by Equation (7).

Using the calibration constants and background concentration values, the total calibrated mean concentration value at each receptor, $\overline{X}_r'$, (for each pollutant) is now given by,

$$\overline{X}_r' = A + B\overline{X}_r + \overline{X}_{BG}. \qquad (9)$$

The values of σ_z (x,S) used in the program are those of Pasquill [1961] and Gifford [1961]. For computation these are represented in the form;

$$\sigma_z = ax^b + c \qquad (10)$$

where

a, b and c values are constants for each stability class, as shown in Table 4-2

No a, b and c values are stated for S = 5 in Table 4-2.

Stability class S = 5 is associated with nighttime, surface inversion conditions, and the σ_z values for this case are the smallest normally used. However, because of the thermal and mechanical influences of urban areas, the lowest part of the typical urban atmosphere is less stable than its rural counterpart. Since the Atmospheric Pollutant Concentration Program is intended for use in urban regions, the σ_z values for S = 4 are always used when the meteorological criteria indicate S = 5.

The minimum value of x used in calculating σ_z is 100 meters. If x <100 meters, x is set equal to 100 meters prior to the σ_z calculation.

TABLE 4-2

COEFFICIENTS FOR σ_z CALCULATION

Stability Class (S)		a	b	c
1 ~ Very Unstable		.001	1.890	9.6
2 ~ Moderately Unstable		.048	1.110	2.0
3 ~ Slightly Unstable		.119	.915	0.0
4 ~ Neutral	x > 1000 meters	2.610	.450	-25.5
	x ≤ 1000 meters	.187	.755	- 1.4

The mixing layer height L, has a marked diurnal, daily and seasonal variation. However, since it is impractical to account for all these variations, a procedure reflecting only major changes is used in the model. The procedure determines mixing height by modifying the average afternoon mixing height values, as tabulated by Holzworth [1964], according to the stability class being considered. Stability classes S = 1, 2 and 3 are afternoon conditions, with S = 1 corresponding to very unstable conditions. When S = 1, the value of L is assumed to be 50% greater than the climatological value tabulated by Holzworth; when S = 2 or 3, the climatological value is adopted. According to Turner's criteria, S = 5 can occur only when night-time ground-based inversion conditions exist. Since a shallow layer of neutral or weak lapse conditions has been found to occur over urban areas (even with strong nocturnal surface inversions in the surrounding rural area), a mixing height of L = 100 meters is adopted for stability class S = 5, when this class is indicated by the objective criteria. The 100-meter value is based upon observations of Clarke [1969]. Stability class S = 4 is a neutral stability condition which occurs either with high wind speeds or with cloudy conditions. To find the mixing height for the transition period between day and night, the afternoon mixing height values are averaged with the 100 meter night time mixing height for 40 percent of the class S = 4 occurrences. The remaining 60 percent of the class utilizes the climatological value.

The effective stack height, h, appearing in Equation (5), is defined as the height of the plume centerline when it becomes horizontal. Thus h = h* + Δh, where h* is the physical stack height and Δh is the plume rise. The effective stack height does not appear in Equation (6) because the height of emission is immaterial after the pollutant is uniformally mixed in the interval.

The plume rise equation used in the program (when actual point sources are being considered) is due to Holland [1953], and is given by

$$\Delta h = \frac{V_s d}{u} \left[1.5 + 2.68 \cdot 10^{-3} P \left(\frac{T_s - T_a}{T_s} \right) d \right] \qquad (11)$$

where:

V_s = stack gas-exit velocity (meters/sec)

d = stack exit diameter (meters)

u = mean wind speed (meters/sec)

P = atmospheric pressure (mb)

T_s = stack gas-exit temperature (°K)

T_a = ambient air temperature (°K)

Since this equation is appropriate for the neutral stability condition, it must be modified when applied over a range of stability conditions. The following modification is used to allow for a range of from 1.3 Δh, for very unstable conditions, to Δh for neutral stability.

$$h = h^* + \Delta h(1.4 - 0.1S) \tag{12}$$

The plume rise Equation (11) frequently underestimates the effective height of emission; thus its use often provides a slight "safety" factor.

If the stack parameters V_s or d are not available for a particular source, or if the user wishes to employ a plume rise equation different from the Holland equation, Equation (11), then an estimate of the plume rise (in the form $u\Delta h$) may be made. The $u\Delta h$ value(defined as the normalized plume rise) is an input to the Source File. If any of the stack parameters V_s or d are not available from the source file and if the $u\Delta h$ value is also not available, the input physical stack height, h, is assumed to represent the effective stack height. If either h or $u\Delta h$ is used in place of Equation (11), the plume rise modification for variable stability is not applied.

For some point sources (e.g., power plants with tall stacks) when the mixing height is low the effective emission height will be above the mixing height. Based on the assumption that the plume will not disperse downward through the stable layer, these cases are identified and eliminated from consideration by the program. For area sources an average effective height of emission must be estimated.

The program computes area source contributions by converting the area sources to equivalent, or "virtual," point sources. In the conversion process, both the downwind distance and source strength are dependent on the particular source-receptor configuration.

If the total emission is assumed to be concentrated at the center of an area source, concentrations downwind tend to be overcalculated, especially for nearby receptors. Since uniform spread of the plume across the sector is assumed, it is logical to proceed a step further and assume a virtual point source at such a distance upwind that the 22.5-degree sector used subtends the area width. This concept is illustrated in Figure 4-4. Here the program would use x instead of x_p as the source-receptor downwind distance in Equation (5) or (6). The vertical spread, as measured by σ_z, is still calculated using x_p, the actual downwind distance.

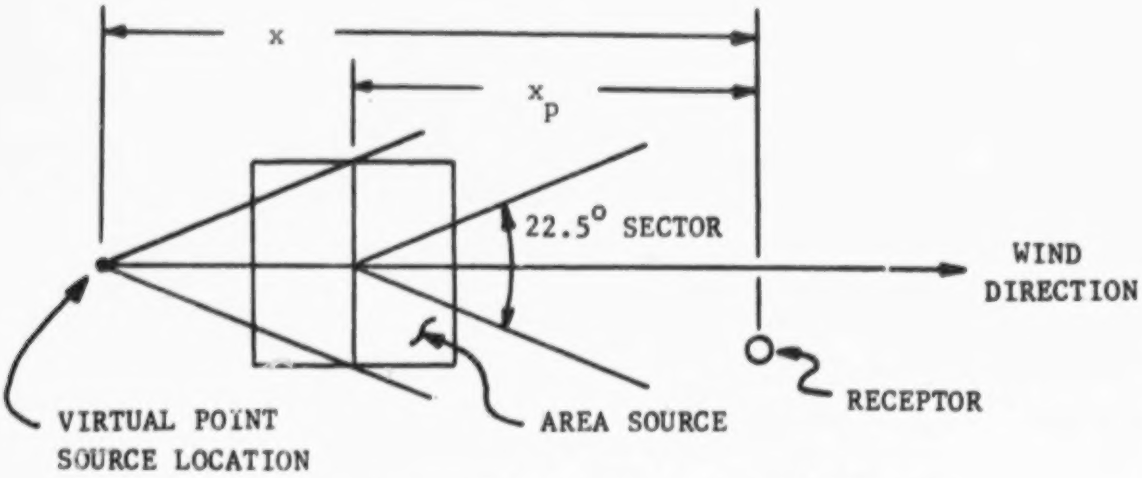

Figure 4-4. Virtual Point Source Concept.

In a similar manner, nearby receptors are affected by emissions from only a portion of the source area and, therefore, would show excessive concentration values if the total area emission value were used. To correct this, the source emission rate is multiplied by an "area utilization" factor, Q*, which is the ratio of that portion of the source area lying within a 22.5-degree sector upwind of the receptor (A') to the total area

(A). For example, in Figure 4-5, Receptor 1 would use the total area-emission value, Q, while Receptor 2 would use the proportional amount, QQ* = A(A'/A). Note that in this figure the virtual point source would be defined by the reduced area width, W.

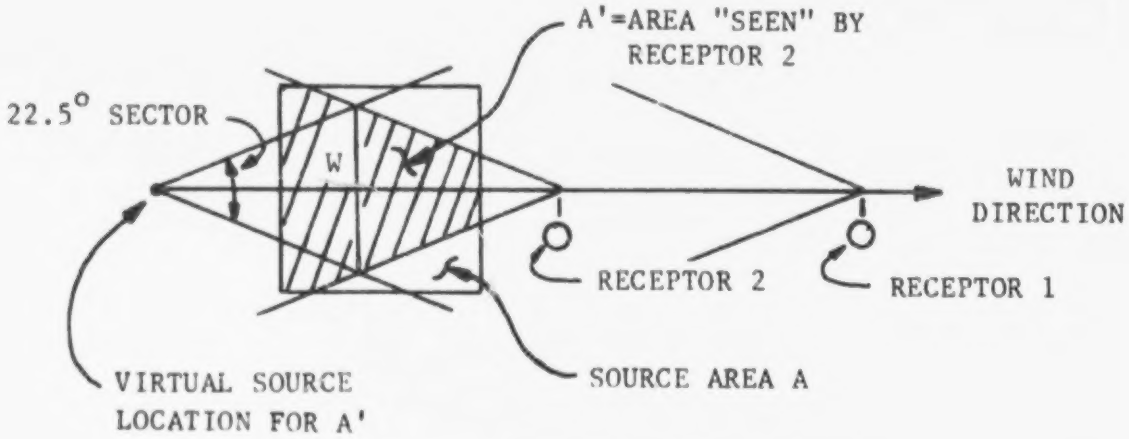

Figure 4-5. Area Utilization Concepts.

To account for decay of the pollutant from the atmosphere, a pollutant decay factor is applied to the concentration value χ, as determined from Equation (5) or (6). The time-based decay factor is given by exp[-.693(x/u)/(3600 T)], where T is the pollutant half-life in hours.

The diffusion model described above should only be applied when competent meteorological advice is available to interpret the limitations in the model. Important cautionary notes include:

(a) The basis of the model calculations, the point source diffusion formula, was developed to represent the behavior of plumes from actual point sources. The field data available for confirmation of the plume behavior were obtained from open, flat terrain and for travel distances of no more than a few kilometers in most cases. Thus, the use of the point-source model for urban scale projections has three specific weaknesses: (1) area sources are only imperfectly modeled by " effective point sources"; (2) plume behavior during horizontal transport of more than a few miles is not well known; and (3) plume behavior in regions of varying thermal and surface-roughness characteristics has not been systematically observed.

(b) The climatological data used in the model calculations are obtained from airport weather observing stations in nearly all cases. Frequently, the character of the lower atmosphere varies significantly between an out-of-town observation site and the urban central region.

(c) The use of surface meteorological data only in the estimation of mixing-layer heights has not been very successful. Better modeling should result when climatological data based upon vertical wind and temperature soundings are used.

(d) The emission inventories presently available for use in the model calculations are subject to error, and they cannot fully describe the individual source characteristics found within the urban region.

(e) The present model uses average emission inventory data. However, significant diurnal and seasonal variabilities in emission rates normally occur. Such variabilities are often (partially) correlated with the stability wind rose data. Future versions of the model should include covariable meteorological and emissions data in the development of seasonal average concentration estimates.

The listing of limitations cited here is not intended to imply that the present model be kept from use. On the contrary, improved models can only be developed when significant experience with the present formulation has been achieved.

4.3.3 Analysis Data Tables

In general, the data manipulations involved in determining the Analysis Data Table output are conversions of the total calibrated mean concentration values to (1) individual source concentrations (Excess and Source Contribution tables) and (2) short-term concentration values (Statistical Table). The specific equations used for each type of table are given below.

4.3.3.1 Excess Table Calculations

For each pollutant the calibrated concentration at receptor, r, from each source, s, is given by

$$\chi'_{rs} = B\chi_{rs} + A\left(\frac{\chi_{rs}}{\bar{\chi}_r}\right), \qquad (13)$$

where B and A are the calibration coefficients for a given pollutant as determined in Equation (1) and χ_{rs} and $\bar{\chi}_r$ are defined by Equation (8).

The Excess Table requires the pollutant contributions from the set of point sources and the set of area sources. These values are obtained by summing Equation (13) over all point sources and then over all area sources.

An additional requirement of the Excess Table is the percent emission reduction required to reduce the excess concentration ($\bar{\chi}'_r - \chi_{standard}$) to zero. The percent reduction is given for both point source control and for control of all sources.

4.3.3.2 Source Contribution Table

This table presents the individual source, χ'_{rs} and the background contribution to each of a selected set of receptors. The calculations of χ'_{rs} is given by Equation (13).

4.3.3.3 Statistical Table

Larsen [1969] has developed a mathematical model for the expression of air pollution concentration as a function of averaging time and frequency, and has demonstrated how the model can be used to relate air quality standards and emission standards. The model is employed here to convert arithmetic average concentrations to expected maximum concentrations and expected geometric mean and percentile concentrations for various averaging times, under the assumption that the standard geometric deviations are known.

The Larsen model was constructed on the basis of the following characteristics, as observed from analysis of seven pollutants for six cities over a three-year period:

(a) Concentrations are approximately lognormally distributed for all pollutants in all cities for all averaging times.

(b) The median concentration (50 percentile) is proportional to averaging time to an exponent.

If air quality data for the major cities are plotted on log-probability paper (for given averaging times) the resulting curves are nearly straight lines. This suggests that, to a good approximation, the distribution of samples follows a lognormal curve. Figure 4-6 represents such a curve, with the logarithm of concentrations plotted on the horizontal axis and the number of samples obtained for each concentration (for a given averaging time) plotted on the vertical axis. The curve follows the familar, bell-shaped probability distribution, the only difference being that the logarithm of concentration is plotted rather than the concentration itself. The center of such a curve falls not on the arithmetic-mean, but on the geometric mean concentration (50-percentile for log-normal distributions). This is the concentration which divides equally the area under the curve: half of the samples will lie above this value and half will lie below it. As with the normal probability curve, the standard deviation is a measure of the "spread" of the curve. However, for the lognormal distribution, it is called the standard geometric deviation, and is the ratio of the concentration which is exceeded by 16% of the samples to that which is exceeded by 50% of the samples.

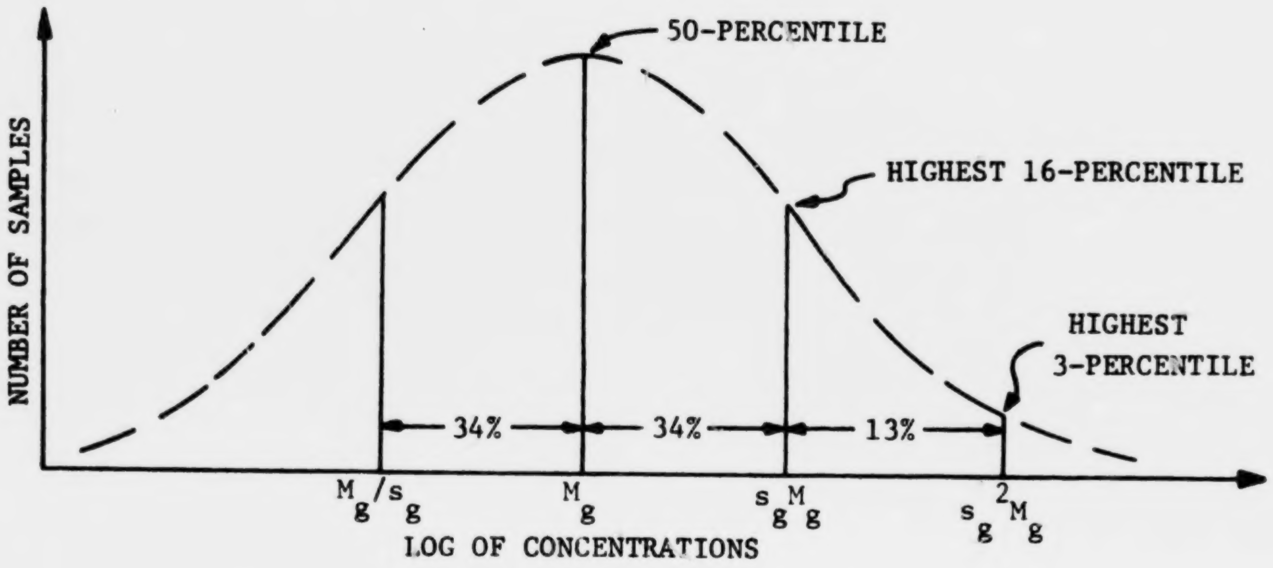

Figure 4-6. Lognormal Distribution of Samples.

Since only two parameters are needed to define the shape of this distribution, it is possible, once these parameters are known, to calculate the concentration for any percentile. In addition, since a specified averaging period corresponds to a fixed number of samples over a year, the highest sample will correspond to a particular percentile. Thus, it is also possible to calculate the expected maximum concentration for the year. Equation (14) is a general relationship for calculating the concentration at any point along the curve as a function of the geometric mean and standard geometric deviation.

$$C = M_g (s_g)^z \tag{14}$$

where:

C = = concentration corresponding to the desired percentile and averaging time,

s_g = standard geometric deviation of samples (at the desired averaging time),

M_g = geometric mean of samples (at the desired averaging time),

z = plotting position which corresponds to the desired percentile.

The parameters M_g and s_g are obtained from the actual distribution of sample data, while z is the number of standard deviations on a normal probability curve that correspond to the desired percentile and may be obtained from statistical tables [c.f., Pearson and Hartley, 1966]. Table 4-3 shows the values of z for several selected percentiles. In the program the z values are obtained by an approximation technique which involves solving the normal, cumulative-probability density function:

$$P = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{+z} e^{-x^2/2}\, dx \tag{15}$$

TABLE 4-3

VALUES OF Z FOR VARIOUS FREQUENCIES

Highest Percentile	z
50.0%	0.00
30.0%	0.52
15.0%	1.04
10.0%	1.28
5.0%	1.64
1.0%	2.33
0.1%	3.09

Since a particular percentile is associated with the maximum concentration in any set of samples for a specified averaging time, a similar table may be prepared in which the values of z correspond to the maximum concentration for selected averaging times. Such values are listed below in Table 4-4 and, when used in Equation (14), they permit calculation of the expected maximum concentration in a distribution of samples (for a single averaging time) where M_g and s_g are known.

TABLE 4-4

VALUES OF Z FOR CALCULATING THE MAXIMUM CONCENTRATION

Averaging Time	z
1 year	0.00
1 month	1.64
24 hours	2.94
8 hours	3.26
4 hours	3.46
2 hours	3.63
1 hour	3.81

The geometric mean for a given set of samples may be calculated from the arithmetic mean and the geometric deviation for that same set of samples in a relatively straightforward manner, as shown in Equation (16).

$$M_g = \chi/(s_g)^{(1/2 \ln s_g)} \tag{16}$$

where:

χ = arithmetic mean

M_g = geometric mean for a set of samples

s_g = standard geometric deviation for the same set of samples

ln = the natural logarithm (base e).

If s_g is for the desired averaging time, Equation (14) and Equation (16) may be used to provide the desired output. If the desired averaging time is different from that associated with the input s_g, then s_g must be translated to the desired averaging time. It is assumed that the input s_g corresponds to a 24-hour averaging time.

Larsen proposes a method to change averaging times by assuming that the median concentration is proportional to averaging time to an exponent. The standard geometric deviations for different averaging times may be related as shown in Equation (17).

$$s_{g_n} = (s_{g_{24}})^k \tag{17}$$

where:

$$k = \sqrt{\frac{\ln 8760/n}{\ln 8760/24}}$$

and

s_{g_n} = standard geometric deviation at averaging period of n hours

$s_{g_{24}}$ = standard geometric deviation of 24-hour samples

The statistical relationships described above, along with the annual arithmetic mean concentration computed by the diffusion model Equation (9), allow the user to estimate the expected maximum, geometric mean and various percentile pollutant concentrations at various averaging times.

4.4 PROGRAM OUTPUT

The types of output associated with each of the operational segments of the Air Pollutant Concentration Program are summarized in this section. Specific examples of output from the Program are given in Section 7.3.4.

4.4.1 Calibration Results

If the calibration option of the model is exercised, the following two sets of calibration data will be obtained.

(a) Correlation Data Table. For each pollutant type considered, the measuring station locations and observed concentration levels (measured minus background) are tabulated.

(x) In addition, the theoretical concentration values (excluding background levels) calculated by the diffusion model at each measuring station location are shown.

(b) Regression Output Table. For each pollutant considered. the y-intercept and slope of the calibration line and the coefficient of correlation are tabulated. Also shown is the theoretical value (5 percent confidence level) expected for the correlation coefficient. If the calculated correlation coefficient is less than the theoretical value, the following note is printed: NOT STATISTICALLY SIGNIFICANT, COEFFICIENTS NOT USED. If the calculated correlation coefficient is greater than or equal to the theoretical value, the following note is printed: STATISTICALLY SIGNIFICANT. If the regression constants are input, only the Regression Table is output, with the following note: VALUES NOT COMPUTED.

4.4.2 Generalized Receptor Output

(a) Receptor Concentration Table. For each pollutant considered, the total calibrated (if applicable) mean concentration values for each receptor will be output in tabular form.

(b) Receptor Concentration Card Deck. At the option of the user, the data contained in the Mean Concentration Table can be obtained as a punched card deck. The format of this deck is described in Section 7.3.4.

4.4.3 Source Contribution File Output

During the calculation of the generalized receptor output, the program creates a Source Contribution File on magnetic tape (or disk). This file is utilized by the Regional Strategies Program to calculate new air quality values (based on application of emission standards). The file contains the following information.

(a) Identification of each source

(b) Calibration constants for each pollutant

(c) Background concentrations for each pollutant

(d) Uncalibrated pollutant concentration for each source-receptor combination, for each pollutant.

4.4.4 Analysis Data Output

The following data may be obtained for each pollutant considered:

(a) Excess Table. This table displays those receptors (maximum of 50) at which the concentration levels exceed an input ambient air quality standard value. For each such receptor, the following information is given:

- Total Concentration - this is the same value as in the Mean Concentration Table.
- Excess Concentration - the amount by which the total concentration exceeds the input standard value.
- Concentration Level From Point Sources - the total point source contribution to the given receptor.
- Concentration Level From Area Sources - the total area source contribution to the given receptor.
- Point Source Reduction Required - this value gives the percent reduction of all point sources required to reduce the excess concentration to zero. A value greater than 100% indicates that the excess concentration cannot be eliminated by control of point sources alone.
- Source Reduction Required - this value gives the percent reduction of all sources required to reduce the excess concentration to zero.

(b) Source Contribution Table. This table presents the pollutant concentration contribution from each source and from the background concentration to five receptors. A note is printed with the table to indicate whether the five receptors have been selected by the user or represent the five highest-concentration receptors. The total concentration values at each of the five receptors (summation of the source and background values) are the same as found in the Mean Concentration Table.

(c) Statistical Table. A table of statistical data for 12 selected receptors may be output for each selected averaging time (maximum of five). Each table is identified with respect to the pollutant being considered and the averaging time for which the data is applicable. The table includes the following information for each selected receptor:

- Mean Concentration values - these are the long-term (annual average) concentration values given in the Mean Concentration Table and do not vary with averaging time.

- Expected Geometric Mean Concentration.
- Expected Maximum Concentration.
- Percentile Concentration - concentration values are given for three selected percentiles.
- Standard Geometric Deviation - the input standard geometric deviation value for a 24-hour averaging time converted to the selected averaging time.

4.5 SOURCE CONTRIBUTION FILE MERGE PROGRAM

For large or densely populated regions, multiple Air Pollution Concentration Program runs might be required to provide sufficient receptor density. The operating procedure for multiple runs is to divide the region into a contiguous set of sub-regions and then execute the program on a sub-region by sub-region basis. This allows use of the full 225 grid - 50 individual receptor system for each sub-region. This procedure will also produce a Source Contribution File for each sub-region. Since the Regional Strategies Program requires a single input Source Contribution File, the set of sub-regional files must be merged.

A file merge program is provided which allows the user to combine all sub-regional files into a single file. This program does not provide any update or listing capabilities. The detailed execution procedures of the Source Contribution File Merge Program are given in Section 7.4.

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5.0 CONTROL COST SEGMENT

5.1 PURPOSE

The Control Cost Segment consists of the Control Cost Program and the Control Cost File Update Program. This segment generates data resulting from application of additional control devices to each point source contained on the Source File.

These data are made available to the user in the form of printed tables, and to the Emission Standards Program as a data file (Control Cost File) on magnetic tape.

The function of the Control Cost File Update Program is to allow an existing data file to be updated without rerunning the Control Cost Program. The update program is described in Section 5.6. The remaining sections in this chapter are devoted to the operation of the Control Cost Program.

5.2 INPUT INFORMATION

The Control Cost Program utilizes data from the Source File and from punched card input. The data required, consisting of the three categories below, are of the type generally collected and used by air pollution control authorities.

- Emission Source Information (from the Source File)
- Regional Information (from punched card input)
- Control Device Information (pre-set or punched card input)

Emission source information is read directly from the Source File by the program. No user generated source data are input to the program. The regional information, relating basically to the fuel availability pattern present in the air quality control region, must be input by the user each time the program is used. The control device information is pre-set in the Control Cost Program. These values may be changed or modified by the user before running the program. Certain other types of data are also included within the program with a user modification option; these data will be described later in this chapter.

Calculation of control cost data requires specific information regarding the type and size of the pollution source being considered. Therefore, since detailed source characteristics for area sources are not available, only point sources are considered by the Control Cost Program. The program input and operating procedures are given in Section 7.5.

5.2.1 Source Information

All point source data contained on the Source File are read into the Control Cost Program. Although all of the point source data are not required by this program, the set must be passed on to the Control Standards Segment (this segment reads only area source data from the Source File). The Source File data utilized by the Control Cost Program consists of the following items:

(a) Identification. Each source is identified in several ways. First, a generic name (such as "Power Plant - Boiler" or "Grain Elevator") describing each source is used. The name facilitates examination of the output records by persons unfamiliar with the various coding schemes used within the program. The four-digit Standard Industrial Classification (SIC) code* must be supplied for each source. Many of the control device selection routines in the program are keyed to the SIC code identification. The two digit process code is also required by this program. It is used, in addition to the SIC code, to specify the exact nature of each emission source.

(b) Effluent Gas Stream. The type and size of control devices applicable to a source are strongly affected by the two gas stream parameters: maximum exhaust gas volume and stack exit temperature. For example, considerably more expensive fabric-filter installations are required when high-temperature gas must be cleaned. The maximum effluent gas volume is the prime factor influencing the cost and size of pollution control devices.

(c) Existing Pollution Controls. The type and efficiency of existing air pollution control devices must be available. When adding new control devices they must be compatible with existing equipment, and their efficiencies must be adjusted to account for pollutant removal by the existing device.

(d) Operating Schedule. The annual hours of plant operation are required in the computation of operating costs for various pollution control devices.

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*SIC and process code classifications used in this program are listed in Table 5-3.

(e) Fuel Usage. For each combustion source, the types, quantities, and sulfur and ash contents of all fuels presently used must be supplied. These data form the basis for determining the applicability and effectiveness of the fuel substitution methods of control. Also, the control efficiency achieved by some of the control devices depends on the type of fuel burned by the pollution source.

(f) Maximum Process Rate. For industrial processes, the maximum process rate is used as the measure of plant capacity which, in turn, is used to determine the types of control measures available to a particular source.

(g) Emission Rates. The actual amount of pollutants emitted by each source is required in numerous calculations (cost, fuel switch, etc.)

5.2.2 Regional Information

The regional information is, in general, specific to the particular air quality control region being considered. For this reason, there are no pre-set values for this type of data, the user must input a complete set of regional data for each run. Although some of the items included in the regional data base may vary somewhat within a given air quality control region, such variations have been determined to be small in comparison to inter-regional differences.

The regional information required includes the following items:

(a) Labor Cost Rate. This is the average hourly wage rate for unskilled labor within the region. Although the quantity of labor required depends on the characteristics of the emission source and the control device applied (see Section 5.2.3), the labor cost rate is determined only by the regional labor market.

(b) Interest Rate. The prevailing interest rate must be specified. This item is used in computing an annual cost based on the purchase and installation costs of control devices.

(c) Fuel Information. Information on fuels available to the region is required for fuel substitution computations. Each geographical area of the country represents an individual situation regarding fossil fuel usage and availability. Data on costs, sulfur content, ash content and heat content must be collected for a variety of fuel types and grades. The user may specify up to and including five grades of coal, five grades of residual oil and three grades of distillate oil. Natural gas is not graded.

For each fuel grade specified, the upper and lower limits (maximum and minimum) of the sulfur content, the average heat content in BTU per ton, gallon, or cubic foot (coal, oil, gas) and the unit cost for three categories of fuel usage must be provided by the user. The three categories of fuel usage are defined as follows: steam-electric power generation, industrial fuel usage (sources having SIC codes beginning with the digits 2 or 3) and general purpose fuel use (all other SIC codes). For each grade of coal, the user must also input the average ash content in percent by weight. In addition, for the control device types 30, 31, and 32 (described in Section 5.3) the user must input the maximum allowable sulfur content for coal, residual oil, and distillate oil (i.e., nine values).

(d) Utility Costs. The cost of electricity and water used in pollutant disposal are required for annual device cost calculations.

5.2.3 Control Device Information

A set of data is required concerning each control device whose application is simulated by the Control Cost Program. The control device information consists of control device description data, which is pre-set, but may be changed by card input, and device applicability data, which is fixed in the program, but may be extended by card input.

Since the set of available control devices is essentially the same for all regions, the control device information is pre-set within the Control Cost Program. Only changes in control technology (such as new or improved devices) or general economic changes will require user input control device descriptive information. For each device, the following device descriptive information is pre-set in the program (the pre-set values are given in Subsection 7.5.4):

(a) Device Identification. A name is given for each control device (e.g., "Electrostatic Precipitator - High Efficiency"). This identification assists in the recognition of the type of control device mentioned in the model output. A three-digit numeric code is also assigned to each control device or measure. This code is utilized internally by the program. The device names and their respective numeric codes are presented in the next section.

(b) Price Coefficients. The cost of each control measure to a particular source is determined by multiplying some measure of the source size by input price coefficients. Usually the measure of size is the number of cubic feet of gas per minute to be treated. For some devices however, the power-generating capacity, fuel usage, or some other measure is used. The price coefficients for most devices were taken from the Control Techniques Documents for Particulates and Sulfur Oxides prepared by the National Air Pollution Control Administration.

(c) Installation Cost Factor. This factor is used in determining the total cost of installing a control device on a particular pollution source. It accounts for those cost elements which depend on the characteristics of the source and of the device itself. The installation cost factor includes the costs of transportation, erection, architectural and engineering, auxiliary equipment, utility connection, startup, spare parts, and land and buildings. For each control device pre-set in the program, a corresponding installation cost factor, which represents a fraction of the total purchase price, is also pre-set. The pre-set factors are those presented in the 1969 NAPCA document, Control Techniques for Particulates.

(d) Expected Life. The length of service expected from each control device is included in each device record. This item is used to apportion the total installed cost of the control device into an annual charge value.

(e) Labor Quantity. This is the yearly amount of labor necessary to operate and maintain each device. Labor quantities associated with four different plant sizes are required. The appropriate value for each particular emission source is selected and applied by the Control Cost Program. The total labor expense, which is one of the major components of device operating and maintenance costs, is calculated as the product of the quantity of labor and the labor cost rate. Labor quantity is computed by converting skilled and supervisory hours into equivalent unskilled hours.

(f) Operating Cost Factors. A number of factors relating to each device are considered in the computation of operating cost. The pressure drop associated with each device is a function of the resistance to gas flow through the device and therefore provides a measure of the amount of power necessary to operate it. Chemical costs give the relative costs of additives used in wet scrubbing when gases in the effluent stream are reacted. If afterburner type devices are used a fuel factor must be included. This factor corrects the computed fuel usage to account for the various heat input requirements (see Particulate Control Techniques Document).

(g) Disposal Cost or Credit. For each pollutant collected, there must be a charge for its disposal. This charge is associated with the control device, since the form in which the pollutant is collected is quite important. If the collected pollutant has value, either directly or by return to a process, then the disposal charge will be negative relative to the other device costs.

(h) Rated Efficiency. These data elements represent the basic removal efficiencies of the control device under consideration for the various pollutants. These efficiencies are modified within the Control Cost Program to reflect variations in source characteristics. The modifications are made on the basis of pre-programmed engineering criteria which take into consideration the effect of existing control devices.

The device applicability data relates each control device to the SIC and process code groups to which it may be applied. Since the SIC and process code list used by the program does not include all possible source types it may be necessary to add additional code numbers. If new SIC and process code numbers are required, the associated device applicability data must also be included. The user may add up to five additional source types (SIC and process codes) and their device applicability data. However, no existing source types or their applicability pre-sets may be changed or deleted from the program nor may any new control device categories be added to the table by this mechanism. These modifications require changes in the program code.

5.3 CONTROL MEASURES

The control devices for which information is pre-set in the program are listed in Table 5-1. This table also indicates the numeric device code used throughout the Implementation Planning Program. A general description of each of the control devices listed in Table 5-1 is given below. Although most of the control devices are designed to remove a particular pollutant, the user should note that some devices (or control methods) simultaneously reduce emissions of two or more pollutants. The user should refer to the pre-set device data (Subsection 7.5-4) for examples of the relative device efficiency difference between high, medium and low efficiency devices.

(a) Wet Scrubbers or Wet Collectors. (Device Codes: 001, 002, 003) are devices which use a liquid, commonly water, to remove particulates or gases directly from a gas stream. The removal is accomplished by contact, or through an increase in the collection efficiency of a second-stage collector by increasing the effective particle diameter. The simplest wet scrubber is a spray chamber into which water is injected by a spray

TABLE 5-1

POLLUTION REDUCTION DEVICES OR METHODS

001	Wet Scrubber - High Efficiency
002	Wet Scrubber - Medium Efficiency
003	Wet Scrubber - Low Efficiency
004	Gravity Collector - High Efficiency
005	Gravity Collector - Medium Efficiency
006	Gravity Collector - Low Efficiency
007	Centrifugal Collector - High Efficiency
008	Centrifugal Collector - Medium Efficiency
009	Centrifugal Collector - Low Efficiency
010	Electrostatic Precipitator - High Efficiency
011	Electrostatic Precipitator - Medium Efficiency
012	Electrostatic Precipitator - Low Efficiency
013	Gas Scrubber
014	Mist Eliminator - High Velocity
015	Mist Eliminator - Low Velocity
016	Fabric Filter - High Temperature
017	Fabric Filter - Medium Temperature
018	Fabric Filter - Low Temperature
019	Catalytic Afterburner
020	Catalytic Afterburner with Heat Exchanger
021	Direct Flame Afterburner
022	Direct Flame Afterburner with Heat Exchanger
027	Eliminate Coal Combustion
028	Eliminate Coal and Residual Fuel Oil Combustion
029	Change all Fuel Use to Natural Gas
030	No Fuel Use Over a Maximum Sulfur Content (Specified by the User in the Regional Data Base*)
031	Same as Device 030 but with a Different Allowable Sulfur Content
032	Same as Device 030 but with a Different Allowable Sulfur Content
039	Catalytic Oxidation - Flue Gas Desulfurization

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*See Section 5.2.2.

TABLE 5-1

POLLUTION REDUCTION DEVICES OR METHODS (Continued)

041	Dry Limestone Injection
042	Wet Limestone Injection
043	Sulfuric Acid Plant - Contact Process
044	Sulfuric Acid Plant - Double Contact Process
045	Sulfur Plant

nozzle. Wet scrubbers applied to a hot gas stream have the additional property of gas cooling and humidification.

(Used for Particulates or Sulfur Oxides)

(b) Mechanical Collectors (004-009) are devices which remove particulate matter from a gas stream by using only the force of gravity or centrifugal force. Nothing is injected into the gas to combine with or entrain the particles. The two principal types of mechanical collectors are:

(1) Gravity Collectors (004, 005, 006). These devices are chambers in which the gas flow is slowed down sufficiently for large particles to settle out. Gravity collectors are typically very low in efficiency except for the removal of relatively large particles, and require considerable space.

(Used for Particulates)

(2) Centrifugal Collectors or Cyclones (007, 008, 009). These devices use the centrifugal force created by spinning the exhaust gas stream to drive particulate matter from the gas. The spinning gas stream is set up inside a cylindrical container by tangential gas inlets, vanes, or fan action.

(Used for Particulates)

(c) Electrostatic Precipitators (010, 011, 012) are devices which remove particles from a gas stream by electrically charging the suspended particles as the gas passes through a corona discharge. The charged particles are then collected on a grounded collection plate. High-voltage precipitators, which are the only electrostatic devices considered by the program, can be operated over a relatively wide range of collection efficiencies. These devices produce a low pressure drop and consequently have low operating costs for large gas volumes. Low-voltage precipitators are not considered since they are generally used for industrial hygiene purposes and not for air pollution control.

(Used for Particulates)

(d) Gas Scrubber (013) is a device in which water (or another liquid) is brought into intimate contact with the effluent gas stream. The pollutants are removed by absorption or by chemical reaction. The cost elements of this device were expressly tailored to gas removal. While this device can be applied for particulate or mist removal it is generally more costly than the alternate devices listed here. Consequently, the program applies this device for gas removal only.

(Used for Sulfur Oxides)

(e) Mist Eliminators (014, 015) are devices designed to remove liquid droplets. The principal collection mechnaisms are interception and impaction. Operation is much like that of fabric filters for dry particulates.

(Used for Particulates)

(f) Fabric Filters (016, 017, 018) are devices which remove particles from a gas stream by passing the gas through fabric tubes or envelopes. A cake of collected particles, supported by the fabric, accomplishes the filtration. Very high effeciencies can be attained using fabric filters. A wide range of fabrics and cleaning techniques are available.

(Used for Particulates)

(g) Afterburners (019, 020, 021, 022) are devices which remove pollutants by combustion. The direct-flame afterburner brings the gas stream into contact with a high-temperature flame to achieve rapid oxidation. The catalytic afterburner operates at a lower temperature by oxidizing the pollutants on the surface of a catalyst.

(Used for Particulates)

(h) Fuel Substitution (027-032) are control methods (rather than devices) involving changes in existing fuel use patterns. They are divided into two basic types in the Control Cost Program:

(1) Elimination of Certain Fuel Types (027, 028, 029). These control methods require a combustion source to meet the demand for heat using specified fossil fuels. Although both particulate and sulfur dioxide emissions are affected by these measures, they are used only for particulate control in this program.

(Used for Particulates)

(2) Fuel Sulfur Content Limitation (030, 031, 032). These control measures restrict the permissible sulfur content of fuels to user input levels. The existing pattern of fuel use (in terms of coal, residual fuel oil, distilute fuel oil, and natural gas) is maintained, as far as possible, consistent with the fuel sulfur limitations.

(Used for Sulfur Oxides)

(i) Flue Gas Desulfurization (039, 041, 042) control measures rely upon injection of various chemicals into the exit gas stream (alternatively, the reactive or catalytic material may be employed in a fixed or fluidized bed). The injected chemicals either react with sulfur oxide directly to produce a readily collectible solid or gas or absorb the sulfur oxide by producing a physically bonded sulfate. The more promising methods for cleaning flue gases are:

(1) Catalytic Oxidation (039). This type of control for sulfur dioxide in the flue gas is a recently developed desulfurization process. After high-temperature oxidation of the SO_2 to SO_3, an absorbing tower procedure using sulfuric acid is employed. Sulfur is recovered as commercially saleable sulfuric acid. This process is reported to be applicable to larger existing installations and to new power generating stations [Stites, et al., 1969].

(2) Limestone Injection - Dry Process (041). This control measure employs finely ground limestone which is injected into the boiler combustion zone. The limestone reacts with the sulfur oxides to form calcium sulfate. The sulfate is then removed from the gas stream by a precipitator or other particulate control device. The process is applicable to both new and existing coal fired electric generating facilities.

(3) Limestone Injection - Wet Process (042). This control measure employes the same basic injection of limestone as the dry process. However, instead of collecting calcium sulfate in the dry state, a liquid slurry of lime is used to remove the sulfate and any unreacted sulfur oxide. The process is applicable to basically the same sources as the dry process described above. The more expensive collection equipment needed may indicate that the wet process may be more often applied to new installations.

(Used for Sulfur Oxides)

(j) By-Product Manufacturing (043, 044, 045). Capitalizes on the fact that either elemental sulfur or sulfuric acid may be manufactured from a sulfur oxide-rich gas. Both products are in relatively high demand in industrial markets, and often can bring a price high enough to substantially offset the cost of controlling emissions. Cases in which sulfuric acid and sulfur plants are used as control measures are not to be confused with cases where similar plants are operated independently in such a manner as to be emission sources themselves. Clearly, a sulfur plant will not be considered a control measure for a sulfur plant emission source.

(Used for Sulfur Oxides)

5.4 PROGRAM OPERATIONS

The Control Cost Program performs three basic functions with respect to each source defined on the Source File.

(a) Control devices, or methods, are assigned to each point source within the region

(b) The expected pollution reduction efficiency is then determined for each source-device combination

(c) Finally, the capital charges and maintenance expense are estimated for each control device.

These steps, described in detail in the following subsections, produce a set of source-device data (defined as a record in the Control Cost File) for all point sources and their applied devices. Output from the program will permit investigation of both overall and detailed pollution control costs. Additionally, comparisons of costs versus pollutant removal effectiveness can be made for the various source-device combinations considered.

5.4.1 Assignment of Control Devices

In general, assignment of a control device to a particular source depends upon a number of engineering factors related to both the source and device characteristics. Within the Control Cost Program, device assignment is performed in two basic steps which produce a list of pollution control devices for each point source defined on the Source File. The first step involves determining those devices which apply to the general source type (defined by their SIC and process code). The second step requires examination of each source within the SIC and process group to determine which of the applicable devices can actually be assigned (i.e., installed) to the source. As will be seen in Subsection 5.4.2.2, some of the devices applied will produce collection efficiencies too low to be useful. The final list of control devices actually applied to each source will include only those remaining after the criteria described in both Subsections 5.4.2.1 and 5.4.2.2 have been applied.

5.4.1.1 Control Device Applicability

Table 5-2 represents an inclusive list of control devices which may be applied to a particular source category. Individual sources within this category, however, may have characteristics which prevent the assignment of certain of the devices. This problem is taken up in the next subsection. This portion of the Control Cost Program merely determines a list of applicable devices for each source type from the total number of control devices available. Table 5-3 defines the source types listed in Table 5-2. The source type identification code scheme used in these tables (and throughout the Implementation Planning Program) is composed of the following sets of numbers:

- A four-digit Standard Industrial Classification (SIC) code, XXXX, which identifies the nature of the industry.
- A two-digit process code, XX, which provides the process classification.

A zero in the second location of the process code (X0) indicates a fuel combustion source. In this case, the first digit (X) identifies the fuel burner type (as defined below). When selecting applicable control devices (Table 5-2) for any source with a combustion source process code, the devices are selected from the Fuel Combustion section of the table (first ten Source Type lines of Table 5-3).

The fuel burner types defined by the process codes 00, 10, 20, ----, 90 are defined as follows:

00. All types Not Listed
10. Pulverized, General
20. Pulverized, Dry Bottom
30. Pulverized, Wet Bottom without Flyash Reinjection
40. Pulverized, Wet Bottom with Flyash Reinjection
50. Cyclone
60. Spreader Stoker without Flyash Reinjection
70. Spreader Stoker with Flyash Reinjection
80. All Other Stokers
90. Hand Dired.

TABLE 5-2

APPLICABLE CONTROL DEVICES

CONTROL DEVICE TYPE

SOURCE TYPE		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
COMB	00							X	X	X	X	X	X				X	X										X	X	X	X	X	X							X		X	X								
	10							X	X	X	X	X	X				X	X										X	X	X	X	X	X							X		X	X								
	20							X	X	X	X	X	X				X	X										X	X	X	X	X	X							X		X	X								
	30							X	X	X	X	X	X				X	X										X	X	X	X	X	X							X		X	X								
	40							X	X	X	X	X	X				X	X										X	X	X	X	X	X							X		X	X								
	50							X	X	X	X	X	X				X	X										X	X	X	X	X	X							X		X	X								
	60							X	X	X	X	X	X				X	X										X	X	X	X	X	X							X		X	X								
	70							X	X	X	X	X	X				X	X										X	X	X	X	X	X							X		X	X								
	80							X	X	X	X	X	X				X	X										X	X	X	X	X	X							X		X	X								
	90																											X	X	X	X	X	X																		
2011	01																					X																													
2029	01																					X																													
2032	01																					X																													
2034	01							X	X	X							X	X	X																																
2041	01							X	X	X							X	X	X																																
	02							X	X	X							X	X	X																																
	03							X	X	X							X	X	X																																
2042	01							X	X	X							X	X	X																																
	02							X	X	X							X	X	X																																
2043	01							X	X	X							X	X	X																																
2046	01							X	X	X							X	X	X																																
2062	01							X	X	X							X	X	X																							X	X								
2082	01																					X																													
2092	01							X	X	X							X	X	X	X	X	X	X																												
2095	01							X	X	X										X	X	X	X																												
	02							X	X	X										X	X	X	X																												
	03							X	X	X																																									
	04	X	X	X				X	X	X							X	X	X																																
2099	01																					X																													
2299	01							X	X	X							X	X	X																																
2445	01							X	X	X							X	X	X																																
2499	01							X	X	X							X	X	X																																
2511	01							X	X	X							X	X	X																																
2671	01													X								X																													
	02													X	X																																				
	03	X																																																	
	04	X									X																																								
	05													X								X																													
	06													X								X																													
2641	01																X	X	X	X	X	X	X																												
2642	01																X	X	X	X	X	X	X																												
2645	01																					X																													
2655	01																X	X	X	X	X	X	X																												
2661	01																X	X	X	X	X	X	X																												
2711	01	X	X	X																X	X	X	X																												
2741	01	X	X	X																X	X	X	X																												
2751	01	X	X	X																X	X	X	X																												
2752	01	X	X	X																X	X	X	X																												
2811	01																			X	X	X	X																												
2816	01	X	X	X				X	X	X							X	X	X																																
	02	X	X	X																																															
	03	X	X	X																																															
	04	X	X	X													X	X	X																																
	05	X	X	X				X	X	X							X	X	X																																
	06	X	X	X				X									X	X	X																																
	07	X	X	X																		X	X																												
2819	01													X																																					
	02													X	X	X																																			
	03	X	X	X											X																																				
	04	X	X	X																																															
	05	X	X	X											X	X																																			
	06	X	X	X													X	X	X																																
	07	X	X	X													X	X	X																																
SOURCE TYPE		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

CONTROL DEVICE TYPE

TABLE 5-2

APPLICABLE CONTROL DEVICES (Continued)

SOURCE TYPE		CONTROL DEVICE TYPE																																																
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	08	X	X	X													X	X	X																																
	09	X	X	X													X	X	X																																
	11	X	X	X													X	X	X																																
	12	X									X	X	X		X																																					
2821	01	X	X	X										X								X	X																											
2822	01															X	X	X																																
2833	01	X	X	X																			X	X																											
2834	01	X	X	X																			X	X																											
2841	01	X												X								X																												
2842	01	X												X								X																												
2843	01	X												X								X																												
2851	01		X	X																X	X	X	X																											
	02																			X	X	X	X																											
	03																			X	X	X	X																											
	04																			X	X	X	X																											
2871	01	X	X	X							X	X					X	X	X																																
2891	01													X																																					
2892	01													X																																					
2899	01													X																																					
2911	01							X	X		X	X																																							
	02										X											X																												
	03																					X																												
	04	X	X	X																																																
	05										X	X	X																																						
	06	X	X	X				X			X	X	X				X	X	X																																
	07										X	X	X																																						
	08							X	X	X	X	X	X																																						
2951	01	X	X	X				X	X	X							X	X	X																																
	02	X						X																																											
	03		X	X																																															
	04	X	X	X																																																
2952	01	X	X	X							X	X	X				X	X	X																																
2992	01	X	X	X							X	X	X				X	X	X																																
2999	01	X	X	X							X	X	X				X	X	X																																
3069	01															X	X	X																																
3079	01																X																																	
3711	01	X	X	X													X	X	X																																
3721	01	X	X	X													X	X	X																																
3741	01							X	X	X	X	X	X				X	X	X																																
	02										X	X	X				X	X	X																																
	03		X	X												X	X	X																																
3751	01	X	X	X				X	X	X							X	X	X																																
3755	01	X	X	X				X	X	X							X	X	X																																
3771	01	X	X	X				X	X	X							X	X	X																																
3772	01	X	X	X				X	X	X							X	X	X																																
3773	01	X	X	X				X	X	X							X	X	X																																
3774	01	X	X														X	X	X																																
	02	X	X														X	X	X																																
3781	01	X	X														X	X	X																																
3791	01	X	X														X	X	X																																
3795	01	X	X	X				X	X	X							X	X	X																																
	02	X	X	X													X	X	X																																
	03	X	X	X													X	X	X																																
3797	01	X	X	X													X	X	X																																
3312	01	X									X	X																																							
	02	X									X	X																																							
	03							X	X	X	X	X	X																																						
	04																																																	
	05	X									X	X					X	X	X																																
	06	X									X						X	X	X																																
	07																																																	
	08	X									X																																								
3313	01	X						X	X	X				X				X	X																			X											
SOURCE TYPE		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
		CONTROL DEVICE TYPE																																																

TABLE 5-2

APPLICABLE CONTROL DEVICES (Continued)

SOURCE TYPE		CONTROL DEVICE TYPE																																																
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
3321	01	X	X					X	X	X							X	X	X																																
	02																																																			
	03																																																			
3322	01										X	X	X				X	X	X																																
3323	01	X	X	X				X	X	X							X	X	X																																
	02																																																			
	03	X									X	X					X	X	X																																
3332	01										X	X		X																														X	X	X					
	02										X	X	X																																						
	03										X	X	X	X																														X	X	X					
	04										X	X	X																																						
	05										X	X	X																																						
3334	01										X	X	X																																						
3339	01										X	X	X																																						
3341	01	X	X	X																																															
	02	X	X	X													X	X	X																																
	03																X	X	X																																
	04	X	X	X													X	X	X																																
	05																																																			
	06	X									X						X	X	X																																
	07	X									X						X	X	X																																
	08	X									X						X	X	X																																
	09	X									X						X	X	X																																
3362	01																X	X	X																																
3369	01																X	X	X	X	X	X	X																												
	02																X	X	X																																
	03																X	X	X																																
	04	X															X	X	X																																
	05	X															X	X	X																																
	06	X															X	X	X																																
	07	X															X	X	X																																
	08																X	X	X																																
3291	01																			X																				X											
3399	01	X	X	X				X	X	X							X	X	X																																
3411	01							X	X	X							X	X	X																																
3441	01																X	X	X																																
3451	01							X	X	X							X	X	X																																
3452	01							X	X	X							X	X	X																																
3519	01																																																			
3639	01																X	X	X	X	X	X	X																												
3661	01																X	X	X																																
4952	01																					X																													
4953	01	X	X	X							X	X	X																																						
	02																																																			
	03	X	X	X							X	X	X																																						
	04	X	X	X							X	X	X																																						
	05	X	X	X							X	X	X																																						
	06																																																			
2818	01	X	X	X																		X	X																												
3296	01	X	X	X				X	X	X							X	X	X																																
3711	01	X	X	X				X	X	X	X	X	X				X	X	X																																
		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
SOURCE TYPE		CONTROL DEVICE TYPE																																																

TABLE 5-3

STANDARDIZED SOURCE TYPES

- 2011 MEAT PACKING PLANTS
  - x0. Combustion*
  - 01. General
- 2013 SAUSAGES AND OTHER PREPARED MEAT PRODUCTS
  - x0. Combustion
- 2026 FLUID MILK
  - x0. Combustion
- 2029 DAIRY PRODUCTS
  - x0. Combustion
  - 01. General
- 2032 CANNED SPECIALTIES
  - x0. Combustion
  - 01. Soups
- 2033 CANNED FRUIT, VEGETABLES, PRESERVES, JAMS, AND JELLIES
  - x0. Combustion
- 2037 FROZEN FRUITS, FRUIT JUICES, VEGETABLES, AND SPECIALTIES
  - x0. Combustion
  - 01. General
- 2041 FLOUR AND OTHER GRAIN MILL PRODUCTS
  - x0. Combustion
  - 01. General
  - 02. Wheat
  - 03. Barley
- 2042 PREPARED FEEDS FOR ANIMALS AND FOWL
  - x0. Combustion
  - 01. General
  - 02. Alfalfa
- 2043 CEREAL PREPARATIONS
  - x0. Combustion
  - 01. General

---

* x0 indicates the group of fuel combustion sources 00, 10,..., 90 described in Subsection 5.4.1.1.

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

2046 WET CORN MILLING

x0. Combustion
01. Starch

2051 BREAD AND OTHER BAKERY PRODUCTS, EXCEPT COOKIES AND CRACKERS

x0. Combustion

2062 CANE SUGAR REFINING

x0. Combustion
01. General

2071 CANDY AND OTHER CONFECTIONARY PRODUCTS

x0. Combustion

2073 CHEWING GUM

x0. Combustion

2082 MALT LIQUORS - BREWERIES

x0. Combustion
01. General

2085 DISTILLED, RECTIFIED AND BLENDED LIQUORS

x0. Combustion

2092 SOYBEAN OIL MILLS

x0. Combustion
01. General

2093 VEGETABLE OIL MILLS, EXCEPT CORN, COTTONSEED, AND SOYBEAN

x0. Combustion

2094 ANIMAL AND MARINE FATS AND OILS

x0. Combustion

2095 ROASTING COFFEE

x0. Combustion
01. Direct Fired
02. Indirect Fired
03. Stones and Cooler
04. Spray Cooler

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

2098 MACARONI, SPAGHETTI, VERMICELLI, AND NOODLES

    x0. Combustion

2099 FOOD PREPARATIONS, NOT ELSEWHERE CLASSIFIED

    x0. Combustion
    01. General

2299 TEXTILE GOODS, NOT ELSEWHERE CLASSIFIED

    x0. Combustion
    01. General

2445 BARRELS

    x0. Combustion
    01. General

2499 WOOD PRODUCTS, NOT ELSEWHERE CLASSIFIED

    x0. Combustion
    01. General

2511 WOOD HOUSEHOLD FURNITURE, EXCEPT UPHOLSTERED

    x0. Combustion
    01. General

2514 METAL HOUSEHOLD FURNITURE

    x0. Combustion

2515 MATTRESSES AND BEDSPRINGS

    x0. Combustion

2591 VENETIAN BLINDS AND SHADES

    x0. Combustion

2621 KRAFT PULP MILLS

    x0. Combustion
    01. Digester Blow System
    02. Smelt Tank
    03. Lime Kiln
    04. Recovery Furnace
    05. Multiple Effect Evaporator
    06. Oxidation Tower

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

2641 PAPER COATING AND GLAZING

x0. Combustion
01. General

2642 ENVELOPES

x0. Combustion
01. General

2645 DIE CUT PAPER AND PAPERBOARD AND CARDBOARD

x0. Combustion
01. General

2651 FOLDING PAPERBOARD BOXES

x0. Combustion

2655 FIBER CANS, TUBES, DRUMS, AND SIMILAR PRODUCTS

x0. Combustion
01. General

2661 BUILDING PAPER AND BUILDING BOARD MILLS

x0. Combustion
01. General

2711 NEWSPAPERS: PUBLISHING, PUBLISHING AND PRINTING

x0. Combustion
01. General

2741 MISCELLANEOUS PUBLISHING

x0. Combustion
01. General

2751 COMMERCIAL PRINTING, EXCEPT LITHOGRAPHY

x0. Combustion
01. General

2752 COMMERCIAL PRINTING, LITHOGRAPHY

x0. Combustion
01. General

2813 INDUSTRIAL GASES

x0. Combustion
01. General

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

2816 INORGANIC PIGMENTS

x0. Combustion
01. Calcination
02. Digestion
03. Chloride Process
04. Chloride Coke or Ore Drying
05. Ore Grinding
06. Titanium Oxide Ore Drying
07. Varnish Reaction Kettles

2818 INDUSTRIAL ORGANIC CHEMICALS, NOT ELSEWHERE CLASSIFIED

x0. Combustion
01. General

2819 INDUSTRIAL INORGANIC CHEMICALS, NOT ELSEWHERE CLASSIFIED

x0. Combustion
01. Sulfur Recovery Incinerator
02. Sulfuric Acid
03. Nitric Acid
04. Ammonium Nitrate
05. Hydrofluoric Acid
06. Calcium Carbide - Coke Dryer
07. Calcium Carbide - Electric Furnace Hood
08. Calcium Carbide - Electric Furnace Vents
09. Calcium Carbide - Stack
10. Calcium Carbide - Calcination
11. Phosphoric Acid

2821 PLASTICS MATERIALS, SYNTHETIC RESINS, AND NONVULCANIZABLE ELASTOMERS

x0. Combustion
01. General

2822 SYNTHETIC RUBBER (vulcanizable elastomers)

x0. Combustion
01. General

2833 MEDICINAL CHEMICALS AND BOTANICAL PRODUCTS

x0. Combustion
01. General

2834 PHARMACEUTICAL PREPARATIONS

x0. Combustion
01. General

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

2841 SOAP AND OTHER DETERGENTS, EXCEPT SPECIALTY CLEANERS

x0. Combustion
01. General

2842 SPECIALTY CLEANING, POLISHING, AND SANITATION PREPARATIONS, EXCEPT SOAP AND DETERGENTS

x0. Combustion
01. General

2843 SURFACE ACTIVE AGENTS, FINISHING AGENTS, SULFONATED OILS AND ASSISTANTS

x0. Combustion
01. General

2851 PAINTS, VARNISHES, LACQUERS, ENAMELS, AND ALLIED PRODUCTS

x0. Combustion
01. Varnish Cookers
02. Alkylresin
03. Cooking and Blowing
04. Polymerization

2871 FERTILIZERS

x0. Combustion
01. General

2891 ADHESIVES AND GELATIN

x0. Combustion
01. General

2892 EXPLOSIVES

x0. Combustion
01. General

2899 CHEMICALS AND CHEMICAL PREPARATIONS, NOT ELSEWHERE CLASSIFIED

x0. Combustion
01. General

2911 PETROLEUM REFINING

x0. Combustion
01. Fluid Catalytic Units
02. Moving Bed Catalytic Units
03. Sulfur Recovery
04. Acid Refining of Lube Oils

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

05. Microfines Unit
06. Calciner Kiln
07. Fluid Coker
08. Process Emissions Source

2951 ASPHALT BATCHING

x0. Combustion
01. Batching
02. Quarrying
03. Rock Drying
04. Sheet Rock Cutting and Trimming

2952 ASPHALT FELTS AND COATINGS

x0. Combustion
01. General

2992 LUBRICATING OILS AND GREASES

x0. Combustion
01. General

2999 PRODUCTS OF PETROLEUM AND COAL, NOT ELSEWHERE CLASSIFIED

x0. Combustion
01. General

3069 FABRICATED RUBBER PRODUCTS, NOT ELSEWHERE CLASSIFIED

x0. Combustion
01. General

3079 MISCELLANEOUS PLASTICS PRODUCTS

x0. Combustion
01. General

3111 LEATHER TANNING AND FINISHING

x0. Combustion

3199 LEATHER GOODS, NOT ELSEWHERE CLASSIFIED

x0. Combustion

3211 FLAT GLASS

x0. Combustion
01. General

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

3221 GLASS CONTAINERS

x0. Combustion
01. General

3241 CEMENT, MANUFACTURING

x0. Combustion
01. Dry Process
02. Wet Process
03. Sand Dryer

3251 BRICK AND STRUCTURAL CLAY

x0. Combustion
01. General

3255 CLAY REFRACTORIES

x0. Combustion
01. General

3271 CONCRETE BLOCK AND BRICK

x0. Combustion
01. Cut Stone and Stone Products

3272 CONCRETE PRODUCTS, EXCEPT BLOCK AND BRICK

x0. Combustion
01. Continuous Process

3273 READY-MIXED CONCRETE

x0. Combustion
01. General

3274 LIME PRODUCTION

x0. Combustion
01. Rotary Kiln
02. Vertical Kiln

3281 CUT STONE AND STONE PRODUCTS

x0. Combustion
01. General

3291 ABRASIVE PRODUCTS

x0. Combustion
01. General

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

3293 GASKETS, PACKING, AND ASBESTOS INSULATIONS

x0. Combustion

3295 MINERALS AND EARTHS, GROUND OR OTHERWISE TREATED

x0. Combustion
01. Crushing
02. Conveying, Screening, and Shaking
03. Storage Piles

3296 MINERAL WOOL

x0. Combustion
01. General

3297 NON-CLAY REFRACTORIES

x0. Combustion
01. General

3299 NON-METALLIC PRODUCTS, NOT ELSEWHERE CLASSIFIED

x0. Combustion

3312 IRON AND STEEL MILLS

x0. Combustion
01. Blast Furnace
02. Basic Oxygen Furnace
03. Sintering
04. Coking Operations
05. Electric Arc Furnace
06. Open Hearth Furnace
07. Bessemer
08. Scarfing

3313 ELECTROMETALLURGICAL PRODUCTS

x0. Combustion
01. Molybdenum Production

3316 COLD ROLLED STEEL SHEET, STRIP, AND BARS

x0. Combustion

3321 GRAY IRON FOUNDRIES

x0. Combustion
01. Cupola
02. Electric Induction
03. Reverberatory Furnace

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

3322 MALLEABLE IRON FOUNDRIES

x0. Combustion
01. General

3323 STEEL FOUNDRIES

x0. Combustion
01. Electric Arc
02. Electric Induction
03. Open Hearth

3332 PRIMARY SMELTING AND REFINING OF LEAD

x0. Combustion
01. Sintering
02. Blast Furnace
03. Reverberatory Furnace
04. Refining of Lead
05. Lead Oxide Manufacturing

3334 PRIMARY PRODUCTION OF ALUMINUM

x0. Combustion
01. General

3339 PRIMARY SMELTING AND REFINING OF NON-FERROUS METALS, NOT ELSEWHERE CLASSIFIED

x0. Combustion
01. General

3341 SECONDARY SMELTING AND REFINING OF NON-FERROUS METALS

x0. Combustion
01. Aluminum - Chlorination Station
02. Aluminum - Crucible Furnace
03. Aluminum - Reverberatory Furnace
04. Aluminum - Sweating Furnace
05. General Aluminum Operations
06. Brass and Bronze - Crucible Furnace
07. Brass and Bronze - Electric Furnace
08. Brass and Bronze - Reverberatory Furnace
09. Brass and Bronze - Rotary Furnace

3352 ROLLING, DRAWING, AND EXTRUDING OF ALUMINUM

x0. Combustion

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

3356 ROLLING, DRAWING AND EXTRUDING OF NON-FERROUS METALS, EXCEPT COPPER AND ALUMINUM

x0. Combustion

3361 ALUMINUM CASTINGS

x0. Combustion

3362 BRASS, BRONZE, COPPER, COPPER BASE ALLOY CASTINGS

x0. Combustion
01. General

3369 NON-FERROUS CASTINGS, NOT ELSEWHERE CLASSIFIED

x0. Combustion
01. Lead - Cupola
02. Lead - Pot Furnace
03. Lead - Reverberatory and Sweating
04. Zinc - Galvanizing Kettles
05. Zinc - Calcine Kilns
06. Zinc - Pot Furnace
07. Zinc - Sweating Furnace
08. Zinc - Distillation Furnace

3391 IRON AND STEEL FORGINGS

x0. Combustion
01. Forge Furnaces

3392 NON-FERROUS FORGINGS

x0. Combustion

3399 PRIMARY METAL PRODUCTS, NOT ELSEWHERE CLASSIFIED

x0. Combustion
01. General

3411 METAL CANS

x0. Combustion
01. General

3441 FABRICATED STRUCTURAL STEEL

x0. Combustion
01. General

3443 FABRICATED PLATE WORK (boiler shops)

x0. Combustion

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

3444 SHEET METAL WORK

- x0. Combustion

3451 SCREW MACHINE PRODUCTS

- x0. Combustion
- 01. General

3452 BOLTS, NUTS, SCREWS, RIVETS, AND WASHERS

- x0. Combustion
- 01. General

3481 MISCELLANEOUS FABRICATED WIRE PRODUCTS

- x0. Combustion

3492 SAFES AND VAULTS

- x0. Combustion

3493 STEEL SPRINGS

- x0. Combustion

3519 INTERNAL COMBUSTION ENGINES, NOT ELSEWHERE CLASSIFIED

- x0. Combustion
- 01. General

3522 FARM MACHINERY AND EQUIPMENT

- x0. Combustion

3531 CONSTRUCTION MACHINERY AND EQUIPMENT

- x0. Combustion

3541 MACHINE TOOLS, METAL CUTTING TYPES

- x0. Combustion

3569 GENERAL INDUSTRIAL MACHINERY AND EQUIPMENT, NOT ELSEWHERE CLASSIFIED

- x0. Combustion

3613 SWITCHGEAR AND SWITCHBOARD APPARATUS

- x0. Combustion

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

3621 MOTORS AND GENERATORS

    x0. Combustion

3639 HOUSEHOLD APPLIANCES, NOT ELSEWHERE CLASSIFIED

    x0. Combustion
    01. General

3661 TELEPHONE AND TELEGRAPHIC APPARATUS

    x0. Combustion
    01. General

3711 MOTOR VEHICLES

    x0. Combustion
    01. General

3712 PASSENGER CAR BODIES

    x0. Combustion

3714 MOTOR VEHICLE PARTS AND ACCESSORIES

    x0. Combustion

3722 AIRCRAFT ENGINES AND ENGINE PARTS

    x0. Combustion

3741 LOCOMOTIVES AND PARTS

    x0. Combustion

3742 RAILROADS AND STREET CARS

    x0. Combustion

3842 ORTHOPEDIC, PROSTHETIC, AND SURGICAL APPLIANCES AND SUPPLIES

    x0. Combustion

3861 PHOTOGRAPHIC EQUIPMENT AND SUPPLIES

    x0. Combustion

3999 MANUFACTURING INDUSTRIES, NOT ELSEWHERE CLASSIFIED

    x0. Combustion

4021 SLEEPING CAR AND OTHER PASSENGER CAR SERVICE

    x0. Combustion

TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

4911 ELECTRIC COMPANIES AND SYSTEMS

- x0. Combustion

4931 ELECTRIC AND OTHER SERVICES COMBINED (electric service less than 95% total)

- x0. Combustion

4952 SEWERAGE SYSTEMS

- x0. Combustion
- 01. General

4953 REFUSE SYSTEMS

- x0. Combustion (fuel)
- 01. Municipal Incinerator
- 02. Open Burning
- 03. On-Site Multichamber Incinerator
- 04. On-Site Single Chamber Incinerator
- 05. Flue-fed incinerator
- 06. Other

4961 STEAM SUPPLY

- x0. Combustion

6513 OPERATORS OF APARTMENT BUILDINGS

- x0. Combustion

8061 HOSPITALS

- x0. Combustion

8221 COLLEGES, UNIVERSITIES, AND PROFESSIONAL SCHOOLS

- x0. Combustion

8999 SERVICES, NOT ELSEWHERE CLASSIFIED

- x0. Combustion

9100 FEDERAL GOVERNMENT

- x0. Combustion

9900 NON-CLASSIFIED ESTABLISHMENTS

- x0. Combustion

9999 AREA SOURCES

The basic references used to match control device to industrial process types were the National Air Pollution Control Administration's Control Technology documents. The device applications shown in Table 5-2 are present in the Control Cost Program as fixed relationships (i.e., they can only be alerted by program modification).

If the Source File contains a pollution source whose SIC or process type is not included in Table 5-2, the user must input the appropriate source-device applicability data for that source. Up to five additional SIC codes and their device application criteria may be added to this table through NAMELIST card input. Since the cost and efficiency characteristics of each device are pre-programmed, only the devices listed in Table 5-1 may be selected as applicable to the additional sources. Those device numbers shown in Table 5-2 but not in Table 5-1 have been included to facilitate future device applications. The user must be thoroughly familiar with the program logic before attempting to utilize these device numbers (i.e., modification of the program). Exact instructions for the NAMELIST card inputs are given in Section 7.5.

5.4.1.2 Control Device Assignment and Effective Rating

Once a list of devices applicable to the particular SIC-Process code has been formulated, specific characteristics of the source must be considered. Each control device category has certain operating requirements which insure compatibility with the source parameters.

(a) Wet Scrubbers (001, 002, 003)

No specific restrictions are placed on the application of these devices on the basis of source parameters.

(b) Gravity Collectors (004, 005, 006)

These devices do not achieve high enough collections to meet current air pollution control levels and will not be utilized in the Implementation Planning Program. They are included here mainly for completeness; specific device applicability criteria are not presented.

(c) Cyclone Collectors (007, 008, 009)

Cyclone collectors are not applicable for the control of particulate emissions from fuel combustion sources burning (predominately) residual or distillate fuel oil or gas. There are no other restrictions on the application of these devices consistent with Table 5-2.

(d) Electrostatic Precipitators (010, 011, 012)

For fuel combustion sources using oil or gas as a major fuel, only the high-efficiency device (010) will be used and its applied efficiency will be set at 75 percent.

(e) Gas Scrubber (013)

No specific source parameters affect the application of this device.

(f) Mist Collector (014, 015)

These devices are applicable at their rated efficiency. However, if the existing device is a mist collector, then only device 014 will be applied and its applied efficiency will be 90 percent.

(g) Baghouse (016, 017, 018)

Only one of these devices will be assigned to any given source. For example, if device 017 is applied, then devices 016 and 018 will not be used. The following criteria have been programmed for this device category:

(1) These devices are not applicable if the existing device is 001, 002, 003, or 013.

(2) If exit temperature is less than or equal to 180°F (355°K) device 018 is used.

(3) If exit temperature is more than 355°K but less than or equal to 394°K, device 017 is used.

(4) If exit temperature is more than 394°K, device 016 is used.

(h) Afterburners (019, 020, 021, 022)

These devices are assigned without restriction.

(i) Fuel Substitutions (027-032)

The program attempts each fuel substitution on every combustion source. If no change in fuel usage is required then no output record is created.

(j) Flue Gas Desulfurization (039, 041, 042)

Assignment of flue gas desulfurization depends on the following conditions:

(1) The source must be a power plant (SIC 4911).

(2) The source must emit more than 20 tons/day of sulfur dioxide.

(3) If more than 40 percent of the usable heat energy of the source is produced by the combustion of coal, then use device 039, 041, and 042.

(4) If less than 40 percent of the usable heat energy of the source is produced by combustion of coal, then only device 039 is used.

(k) Sulfuric Acid - Sulfur Plants (043, 044, 045)

These control measures should be applied as specified in Table 5-2 when the source's emissions are greater than 20 tons/day of sulfur dioxide.

If the temperature of the gas entering the control device (approximated by exhaust temperature) exceeds 532°K, the program will reduce the temperature to an acceptable level and determine the associated cost. Subsection 5.4.2.4 details the calculations required.

The basic pollutant collection efficiency of each assigned device is adjusted to account for the particular characteristics of the source to which it has been applied. All such efficiency corrections used in this program relate to the particulate collection efficiency. Sulfur oxide removal efficiency is calculated on the basis of the unadjusted rated efficiencies.

If a control device is assigned to a source with an existing device (as defined by the Source File) and if a high degree of particulate removal has already been achieved, additional collection is quite difficult. To account for the reduced efficiency of "second" devices, Table 5-4 has been created and programmed as a part of the Control Cost Program. Efficiency corrections for the three most widely used types of particulate collectors are calculated on this basis. After the correction factor has been determined (for the approporiate device classifications) from Table 5-4, the actual applied efficiency is calculated by means of the following equation:

Applied Eff. = 1. - (1. - Rated Eff.) (Correction Factor)

TABLE 5-4

EXISTING DEVICE CORRECTION FACTORS

Existing Efficiency	Correction Factor: Wet Scrubber (001,002,003)	Correction Factor: Dry Cyclone (007,008,009)	Correction Factor: Electrostatic Precipitator (010,011,012)
> 0 and ≤40	1.0	1.0	1.0
>40 and ≤60	1.1	1.3	1.0
>60 and ≤65	1.2	1.8	1.1
>65 and ≤70	1.3	2.3	1.2
>70 and ≤75	1.5	2.7	1.3
>75 and ≤80	1.8	3.2	1.6
>80 and ≤83	2.2	3.8	2.0
>83 and ≤86	2.6	4.4	2.5
>86 and ≤89	3.1	5.1	2.9
>89 and ≤91	3.5	5.8	3.4
>91 and ≤93	4.1	6.6	3.9
>93 and ≤95	4.7	7.6	4.4
>95 and ≤97	5.5	9.0	5.4
>97 and ≤99	7.3	11.0	7.5
>99 and ≤100	10.0	12.0	11.0

Applied Efficiency and Rated Efficiency are decimal fractions. The rated efficiency is given in the device record for each control device. An example of this efficiency is as follows:

> A high-efficiency electrostatic precipitator (010) is applied to a source already employing a 99 percent efficiency particulate collection system. According to Table 5-4, a factor of 7.5 should be used; the actual applied efficiency will be:
>
> Applied efficiency = 1 - (.01) 7.5 = .925
>
> = 92.5% instead of the rated 99%.

Should the effect of this correction be to reduce a device's applied particulate collection efficiency below 30 percent, then that source-device combination is rated not acceptable and is not included in the output records. Only after a device has been rated acceptable for a specific source (according to criteria presented in this and the previous subsection) are the cost calculations carried out. After the set of assigned control devices has been determined for each pollution source, the costs associated with applying and operating each device are calculated.

5.4.2 Cost Calculations

The total annual cost resulting from the assignment of a control device to a source involves the component costs: purchase cost, installation cost, interest charges, and operating and maintenance cost. The calculations involving each of these component costs are described in the following subsections.

5.4.2.1 Purchase Cost

The purchase cost of control devices depends, in general, upon the characteristics and complexity of the control device and the size of the pollution source to be controlled. In the Control Cost Program, these parameters are used to determine a basic purchase cost equation for each control device. The general form of this equation is:

$$y = a + bx + cx^2,$$

where y = purchase cost in thousands of dollars, and a, b, and c are user input coefficients in the device specification. Experience has shown that the coefficient c in the above equation can be set equal to zero in most instances. Table 5-5 displays the pre-set coefficients associated

TABLE 5-5

MANUFACTURER'S PRICE

Control Measure		Purchase Cost Equation
Wet Collector		
001	High Efficiency	$y = 2.886 + .228x$*
002	Medium Efficiency	
003	Low Efficiency	$y = 1.257 + .145x$
Mechanical Collectors		
Gravity Collectors		
004	High Efficiency	$y = -.445 + .326x$
005	Medium Efficiency	$y = -.042 + .155x$
006	Low Frequency	$y = .003 + .056x$
Centrifugal Collectors		
007	High Efficiency	$y = 2.413 + .197x$
008	Medium Efficiency	$y = 1.507 + .157x$
009	Low Efficiency	$y = .244 + .099x$
Electrostatic Precipitators		
010	High Efficiency	$y = 42.413 + .623x$
011	Medium Efficiency	$y = 31.243 + .441x$
012	Low Efficiency	$y = 19.695 + .318x$
Fabric Filters		
016	High Temperature Type	$y = 1.448 + .838x$
017	Medium Temperature Type	$y = 3.478 + .448x$
018	Low Temperature Type	$y = 2.658 + .325x$
Gas Scrubber		
013		$y = 3.175 + .251x$
Mist Eliminator		
014	High Velocity	$y = 2.658 + .325x$
015	Low Velocity	$y = 1.772 + .217x$

---

*Cost Functions $y = 10^3$ Dollars, $x = 10^3$ ACFM.

TABLE 5-5

MANUFACTURER'S PRICE (Continued)

	Control Measure	Purchase Cost Equation
Increased Combustion Efficiency (Afterburner)		
019	Catalytic Combustion	$y = 7.550 + 1.515x$*
020	Catalytic with Heat Exchange[1]	$y = 7.550 + 1.515x$
021	Direct Flame Combustion	$y = 5.713 + 1.174x$
022	Direct Flame with Heat Exchange[1]	$y = 5.713 + 1.174x$
Fuel Substitution[2]		
Flue Gas Desulfurization[3]		
039	Catalytic Oxidation	$\log_{10} y = -12.412 + 1.67 \log_{10} x$
041	Limestone Injection (dry)	$y = 9.95 \cdot 10^{-7} x - 6.03 \cdot 10^{-17} x^2$
042	Limestone Injection (wet)[4]	$y = 1.108 \cdot 10^{-6} x - 4.81 \cdot 10^{-17} x^2 + 9.572 \cdot 10^{-8} sx - 4.16 \cdot 10^{-18} sx^2$
By-Product Manufacture		
043	Sulfuric Acid Plant (Contact Process)	(See Page 5-44, item (f))
044	Sulfuric Acid Plant (Double Contact)	
045	Sulfur Plant	

---

*Cost Functions $y = 10^3$ Dollars, $x = 10^3$ ACFM.

[1] Heat exchangers are considered accessory equipment and their costs are included under installation costs.

[2] Fuel substitution cannot be represented by a simple formula. A complete explanation of the procedure used to compute the cost of fuel substitution is found in Section 5.4.5.

[3] The "x" terms in the equations should be at the rated capacity of the source (BTU/hr).

[4] In practice, this process only applies to coal. The parameter "s" appearing in the cost equation is the sulfur content in percent by weight (i.e., $0 \leq s \leq 100$).

with each control device included in the Control Cost Program. The variable x represents the measure of the source's size, as described below.

(a) Devices 001, 002, 003, 013

For these devices, x is exhaust gas volume in thousands of ACFM. Since a temperature change occurs in these wet collection devices, a new exhaust volume based on the original gas volume is computed, as follows:

$$T_n = 294 + .097\ (T_o - 294)$$

where T_n = new exit temperature (°K)

T_o = exit temperature as obtained from the Source File (°K)

then

$$x = C_o(T_n/T_o)$$

where C_o = exhaust gas volume as obtained from the Source File (ACFM)

(b) Devices 004-012 and 014-018

The parameter x is the exhaust gas volume in thousands of ACFM as obtained from the source file, with no corrections applied.

(c) Devices 019-022

The parameter x in these purchase price equations is the actual exhaust gas emission rate. As these devices (afterburners) also produce a change in the exit temperature, adjustments must be made. The new exit temperature (T_n) is given by:

$$T_n = T_o + t$$

where T_o = existing exit temperature (°K)

t = 288 for device 019
139 for device 020
556 for device 021
222 for device 022

(d) Device 039

For this device, x is the logarithm (base 10) of the rated capacity of the plant (BTU/hr.), and y is the logarithm (base 10) of the purchase cost (10^3 $).

(e) Devices 041-042

For these devices, x is the rated capacity of the plant (BTU/hr.) as obtained from the Source File.

(f) Devices 043-045

For these devices, x is the logarithm (base 10) of the amount of sulfur in the exhaust gas in tons/day, calculated as follows:

$$x = \log_{10} (E_s/2)$$

where E_s = annual SO_2 emission rate as obtained from the Source File (tons/day).

For these devices the price coefficient "a" is determined by the program. This is done on the basis of the device and the percent by volume of sulfur dioxide in the exhaust gas. This percent is calculated using the following formula:

$$P = 18.48 E_s T/V$$

where E_s = annual sulfur dioxide emission rate as obtained from the Source File (tons/day)

T = exit temperature as obtained from the Source File (°K)

V = exhaust gas volume as obtained from the Source File (ACFM)

P = percent sulfur dioxide by volume in the exhaust gas

The quantity "a" (to be used in the cost equation) is then determined as follows:

	Device 043	Device 044
$0 \leq P \leq 3.0$	$a = -0.8218$	$a = -0.7426$
$3.0 < P \leq 6.0$	$a = -1.0647$	$a = -0.9855$
$6.0 < P \leq 10.0$	$a = -1.2937$	$a = -1.2145$
$P > 10.0$	$a = -1.3449$	$a = -1.2657$

	Device 045
$0 \leq P \leq 5.0$	$a = -0.5779$
$5.0 < P \leq 7.0$	$a = -0.7069$
$P > 7.0$	$a = -0.7629$

In this case the "y" value, which the cost equation gives, is not the purchase cost in thousands of dollars as it is for other devices; instead it is the logarithm (base 10) of the purchase cost in millions of dollars.

In summary, the cost equation for devices 043, 044, and 045 is:

$$y = a + bx$$

where y = logarithm (base 10) of purchase cost (10^6 \$)

a = number determined by device type and percent SO_2 in exhaust gas.

b = user input Manufacturer's Price Coefficient No. 2.

x = logarithm (base 10) of the amount of sulfur in the exhaust gas (tons/day).

A final test is made to eliminate very low efficiency devices (based on purchase cost). If y is less than $1.0 \cdot 10^6$ for device 043, $1.2 \cdot 10^6$ for device 044; or $2.5 \cdot 10^6$ for device 045, the device is not applied.

When the corrosive gas stream from acid manufacturing facilities are controlled, more expensive control device construction materials must be used. For these cases the Control Cost Program, utilizes the following factors to increase the device purchase price:

If exit temperature ≤ 330°F, multiply purchase cost by 1.7.
If exit temperature > 300°F, multiply purchase cost by 5.0

5.4.2.2 Installation Cost

The cost of installing a control device on a particular source is calculated on the basis of an installation cost factor. This factor is expressed as a percentage of the purchase price and is a user input item for each control device. The program sums purchase cost and installation charge to determine the total installed cost for each source-device combination.

For some control device installations however, extensive modifications of the source are required and it is not possible to identify a purchase cost figure independent of the installation charge. For these devices, the total installed cost is estimated by the purchase price equations described in Subsection 5.4.2.1. No additional factor is required in these cases to account for installation at a source site. Devices in this category are the flue gas desulfurization units (039, 041, 042) and by-product manufacturing facilities (043, 044, 045).

5.4.2.3 Annual Capital Charge

After the total installed cost (purchase plus installation) of a device has been determined, an annualized capital charge is calculated, based on the user inputs: rated life of the control device and prevailing interest rate. Therefore, the annual cost comprises both depreciation of the initial investment total (installed cost from Subsection 5.4.2.2) and the interest costs.

The particular accounting technique employed here is called the Capital Recovery Factor (C.R.F.). The use of the C.R.F. allows the write-off of the initial investment to be divided into a uniform series of end-of-year payments.

The C.R.F. multiplied by the initial investment cost (debt) determines the uniform end-of-year payments necessary to repay the debt in "N" years (the rated life of the device) with an interest rate "i." The C.R.F. is calculated by the following relation:

$$\text{C.R.F.} = \frac{i(1+i)^N}{(1+i)^N - 1}$$

The annual capital charge is then computed to be the product of the total installed cost and the C.R.F. value.

In practice, the capital recovery concept operates as follows:

(1) Payments are made at the end of each year in the amount determined by multiplying the capital recovery factor by the initial debt.

(2) Interest payments are made to the bondholders at the end of each year in the amount determined by multiplying the interest rate by the initial debt.

(3) The difference between the equal annual payments and the interest payments to the bondholders is placed into a depreciation account where it is assumed to draw interest at the same rate paid to the bondholders.

The total yearly cost to the source for controlling pollution by means of a specified device is then the sum of the annual capital charge and the annualized operating and maintenance expense discussed in the next subsection.

5.4.2.4 Operating and Maintenance Expense

Operating and maintenance (O&M) expenses are usually a major portion of the annualized control device cost. The factors which must be considered in determining the annual O&M cost of a particular source-device combination consist of: the amount of power (calculated as electrical power) necessary to maintain the effluent gas flow through the control device, the quantity of labor required, the cost of liquid or additional fuel used by the device, and the cost or credit resulting from disposal of the collected pollutant. These factors are used in the following equations to determine the O&M cost for each type of control device pre-set in the program.

For control devices 001 through 022, a single equation is used to compute the annual O&M cost:

$$O\&M = AB + CD + EF + GI + JK + LM,$$

where A = electricity quantity (kwhr/yr) (a)*
B = electricity cost ($/kwhr) (input as regional data)

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[*] The letters refer to the following items which describe the computation of these data elements.

C = water quantity (gal/yr) (b)
D = water cost (\$/gal) (input as regional data)
E = chemical quantity (ton/yr) (c)
F = chemical cost (\$/ton) (input as device data)
G = fuel quantity (cu.ft./yr) (d)
I = fuel cost (\$/cu. ft.) (natural gas value, input as regional data)
J = disposal quantity (ton/yr) (e)
K = disposal cost (\$/ton) (input as device data)
L = labor quantity (hr/yr) (f)
M = labor cost (\$/hr) (input as regional data)

The computation of these data elements are as follows:

(a) Electricity Quantity (kwhr/yr) = $(1.955\ 10^{-4})pVH$

where p = pressure drop (in H_2O)

V = exhaust gas volume (ACFM) this is the new computed volume (x) in the case of a wet device (Subsection 5.4.2.1 item (a)).

H = operating hours (hr/yr)

If the device is one of the electrostatic precipitators (010, 011, 012), the following quantities are added to the electricity quantity:

Device 010, add $(0.34\ 10^{-3})$ VH

Device 011, add $(0.26\ 10^{-3})$ VH

Device 012, add $(0.19\ 10^{-3})$ VH

(b) Liquid Quantity (gal/yr) = $(3.0\ 10^{-2})$ VH

The liquid quantity is only computed for wet devices (001, 002, 003, 013). For these cases the exhaust gas volume (V) will always be the new computed volume.

(c) Chemical Quantity (ton/yr) = $P_s H$

where P_s = amount of SO_2 removed by the device.

(d) Fuel Quantity = fVH

where f = 0.490, if device 019

0.245, if device 020

1.000, if device 021

0.404, if device 022

0.000, all other devices

It should be noted that additional fuel is only used for the catalytic and direct flame afterburners. The program assumes that the additional fuel is natural gas.

(e) Disposal Quantity - Emission rate for pollutant in question (tons/day) times new device efficiency (after adjustment) for same pollutant times 365 (days/year).

This is computed for each of the pollutants.

(f) Labor Quantity = LH

Where H = operating time (hr/yr)

L = labor (labor hours/operation hours)

There are four, user input, labor values which relate to the source size being controlled (small, medium, large, and extra large). Source size is measured by V, actual cubic feet of exhaust gas per minute (as corrected). The program selects the appropriate value as follows:

Use the "small" value for	$V \leq 40{,}000$
Use the "medium" value for	$40{,}000 < V \leq 250{,}000$
Use the "large" value for	$250{,}000 < V \leq 1{,}000{,}000$
Use the "extra large" value for	$V > 1{,}000{,}000$

For any particular control device, only some of the terms in the above equation will be non-zero. An electrostatic precipitator, for instance, will not use liquid, chemicals, or additional fuel. The quantity JK however, will always be calculated.

Operating and maintenance costs for the remaining control devices cannot be estimated by the above calculations. These devices are generally more complex (involving sulfur oxide removal), and separate equations have been developed to compute their O&M expenses. These equations are based on manufacturers' specifications and operating experience reported in the literature.

For the three flue gas desulfurization measures considered, the following calculations of operating cost are used.

Device 039 - Catalytic Oxidation

$O\&M = 0.05 \cdot (\text{total installed cost}) + AB + JK$

Where A, B, J, and K are as defined above.

Device 041 - Dry Limestone

$O\&M = 365\ P_c\ (0.17 + 7.0\ SC_c) + 25{,}000$

Device 042 - Wet Limestone

$O\&M = 365\ P_c\ (0.196 + 3.82\ SC_c) + 130{,}000$

where P_c = coal burned in ton/day (Source File)

S = coal sulfur content, decimal (Source File)

C_c = chemical cost in \$/ton (input as device data)

The O&M costs associated with the use of sulfuric acid or sulfur by-product manufacturing as a pollutant control measure (devices 043, 044, and 045) are computed from the following equation:

$O\&M = JK - (\text{Purchase Cost})/(\text{Rated Life}) + y$

where, for each device:

J = disposal quantity, as calculated in item (e) above.

K = input disposal cost

Purchase Cost = value computed in Subsection 5.4.2.1, item (f)

Rated Life = input as device data

y = value as calculated below. The variable P used in these computations is the percentage concentration of sulfur dioxide, by volume, in the exhaust gas as given in Subsection 5.4.2.1, item (f).

Devices 043, 044 - Sulfuric Acid Plant - Single Contact and Double Contact Process

$\log_{10} y = 0.75 \log_{10} x + a$

where y = annual cost (in 10^6 \$)

x = sulfur emission in ton/day

if $0 \leq P < 3.0$, then $a = 1.6903$

$3.0 \leq P < 6.0$, then $a = 1.4445$

$6.0 \leq P < 10.0$, then $a = 1.2076$

$P > 10.0$, then $a = 1.721$

Device 045 - Sulfur Plant

$$\log_{10} y = 0.81 \log_{10} x + a$$

where y = annual cost (in 10^6 \$)

x = sulfur emission (above)

if $0 \leq P < 5.0$, then $a = -1.210$

$5.0 \leq P < 7.0$, then $a = 1.375$

$P \geq 7.0$, then $a = 1.435$

In addition to the O&M costs described in this Subsection, the program calculates the cost of necessary cooling of the effluent gas stream prior to device application. This cost is calculated whenever the temperature of the gas entering the cooling device (approximated by the exhaust gas temperature) exceeds 532°K (500°F). The cost computations, performed for each source assigned device combination, are as follows:

If exhaust gas volume is greater than or equal to 2000 ACFM but less than 6800 ACFM,

$$\text{Cost (\$)} = 1131.7 \left| e^{[.436 \ln (s/1000)]} \right| + 124 + .07185\, S'$$
$$+ S[(.0003225 + .000016286 \quad \frac{.24T - 71.2}{T})\ H$$
$$+ \frac{.0000019\ (.24T - 71.26)\ H}{T} + .04]$$

If exhaust gas volume is greater than or equal to 6800 ACFM but less 100,000 ACFM

$$\text{Cost } (\$) = 720.17 \left[e^{[.668 \ln (S/1000)]} \right] + 124 + .07185\, S'$$

$$+ S[(.0003225 + .000016286\ \frac{.24T - 71.2}{T})\ H$$

$$+ \frac{.0000019\ (.24T - 71.2)}{T}\ H + .04]$$

where

S = exhaust gas volume (ACFM)

S' = volume of cooled gas to control device (ACFM @ 500°F)

= $S[526.2 + .023T]/T$

H = operating hours per year

= $365 \cdot$ (number of shifts/day) $\cdot\ 8$

T = exhaust gas temperature (°K)

If the gas volume is less than 2000 ACFM the program will not apply the device being considered, and will go on to the next assigned device.

If the gas volume is greater than 100000 ACFM, the program will divide the ACFM value into equal parts, each of which is less than 100000 ACFM. The gas cooling data will then be calculated using the procedure described above. The resulting cost and cooled exhaust gas volume is then multiplied by the number of equal parts to produce the total values for the device.

The costs calculated above combine purchase, installation, and operating costs for the gas cooling measure (assumed to be of the water spray type) and are on an annualized basis. The new exhaust gas volume (S') and new exhaust gas temperature (532°K) become the new source-device characteristics.

The total annual device cost, output by the program, is then the annual capital cost (defined in Subsection 5.4.2.3) plus the O&M cost and, if applicable, the gas cooling cost described in this subsection.

5.4.3 Fuel Substitution

In addition to the devices just described, a set of emmision control methods have been included in the Control Cost Program. These methods are designed to provide a reduction in combustion source emissions by using fuel substitutions to modify the existing fuel use pattern. The following sections describe the data inputs required, the calculations used, and the types of output values created by the various fuel substitution measures.

5.4.3.1 Fuel Parameters and General Calculations

The fuel substitution portion of the Control Cost Programs uses the data items shown in Table 5-6 (obtained from the locations indicated).

Prior to entering a specific fuel substitution routine, the program calculates the following quantities in the manner shown. These quantities are calculated once for each point source and are used later in the various fuel substitution calculations.

(1) BTU contribution of each fuel burned, B_i[†]

(a) B_i(BTU/year) = $A_i\ H_i$ (Boiler Eff)$_i$ 365[*]

(2) Annual cost of each fuel burned, P_i

(a) P_i(\$/year) = $C_i\ A_i$ 365

(3) Potential emission from each fuel burned, E_{ji}[**]

(a) E_{SC}(ton/day) = $19.0\ A_C\ S_C\ 10^{-3}$

(b) E_{SR}(ton/day) = $79.3\ A_R\ S_R\ 10^{-6}$

(c) E_{SD}(ton/day) = $71.8\ A_D\ S_D\ 10^{-6}$

(d) E_{SG}(ton/day) = $0.2\ A_G\ 10^{-9}$

(e) E_{PC}(ton/day) = $0.5\ A_C\ a\ f_1\ 10^{-3}$

(f) E_{PR}(ton/day) = $0.5\ A_R\ f_2\ 10^{-6}$

[†] See Table 5-6 for subscript identification

[*] See Table 5-7 for (Boiler Eff)$_i$ values.

[**] See Tables 5-8 and 5-9 for f_1 and f_2 values respectively.

TABLE 5-6

FUEL PARAMETERS

Symbol	Variable Name	Units	Where Obtained
--	Source ID number	--	Source data
A_i	Amount of each existing fuel burned	Tons, gallons, cu. ft. per day*	Source data
S_i	Sulfur content of each existing fuel burned	Percent by weight (decimal equivalent)	Source data
H_i	Heat content of each existing fuel burned	BTU per ton, gallon or cu. ft.*	Source data
a	Ash content of coal burned	Percent by weight (decimal equivalent)	Source data
D_j	Existing device efficiency for each pollutant	Decimal fraction	Source data
e_j	Emission rate for each pollutant	Tons per day	Source data
C_i	Unit cost of each existing fuel burned	Dollars per ton gallon, cu. ft.*	Region data
S_{Ni}	Sulfur content of each new fuel available	Percent by weight (decimal equivalent)	Region data
H_{Ni}	Heat content of each new fuel available	BTU per ton, gallon or cu. ft.*	Region data
a_N	Ash content of each new coal available	Percent by weight (decimal equivalent)	Region data
MA_i	Maximum allowable sulfur content for each fuel type	Percent by weight	Region data

i subscripts refer to type of fuel (C - coal, R - residual oil, D - distallate oil, G - gas)

j subscripts refer to pollutant (S - SO_x, P - particulate)

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[*] For coal, oil and gas respectively.

TABLE 5-7

BOILER EFFICIENCES

BTU Range	Efficiency			
	Coal	Residual Oil	Distillate Oil	Natural Gas
Annual BTU Output $\geq 0.1 \times 10^9$	.87	.86	.86	.82
Annual BTU Output $< 0.1 \times 10^9$	.75	.77	.77	.80

NOTE: Boiler efficiencies are utilized in the following manner to calculate the amounts of new fuel required:

1. Assume annual BTU $> 0.1 \times 10^9$
2. Use efficiencies from first row.
3. Compute: $H_i A_i Eff_i$ for each fuel (i) and total them together
4. If total in No. 3 is less than 0.1×10^9, then the initial assumption (step 1) was incorrect and the computation is redone using the set of efficiencies from the second row.

TABLE 5-8

(f_1) COAL PARTICULATE EMISSION FACTORS

Process No.	Combustion Type	f_1
00	All types not listed	15
10	Pulverized, general	16
20	Pulverized, Dry bottom	17
30	Pulverized, Wet bottom without fly ash reinjection	13
40	Pulverized, Wet bottom with fly ash reinjection	24
50	Cyclone	2
60	Spreader Stoker without fly ash reinjection	13
70	Spreader Stoker with fly ash reinjection	20
80	All other stokers	5
90	Hand fired	20/a[*]

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[*] a = ash content of coal burned, percent by weight (decimal equivalent).

TABLE 5-9

(f_2) OIL AND GAS PARTICULATE EMISSION FACTORS

Fuel	SIC codes		
	4911	2xxx, 3xxx	All Other
Residual Oil	8	23	23
Distillate Oil	6.5	15	15
Natural Gas	15	18	19

(g) $E_{PD}(\text{ton/day}) = 0.5\ A_d\ f_2\ 10^{-6}$

(h) $E_{PG}(\text{ton/day}) = 0.5\ A_G\ f_2\ 10^{-9}$

S_C, S_R, S_D and a are all expressed as a percent (i.e., a number between 0 and 100). The coefficients were obtained by combining conversion dimensional factors with appropriate emission factors (generated by HEW).

To insure the compatibility of the input data, the program next compares the input total emission rates (e_j) with the calculated fuel emission rates (E_j). This comparison is made as follows (where the emission rates have have been corrected for any existing control devices):

(a) $(E_{SC} + E_{SR} + E_{SD} + E_{SG})\ (1 - D_S) = E_S$

(b) $(E_{PC} + E_{PR} + E_{PD} + E_{PG})\ (1 - D_p) = E_p$

If $0.8 \leq \frac{E_S}{e_S} \leq 1.2$ and $0.8 \leq \frac{E_P}{e_p} < 1.2$, then the input data is assumed to be correct for the purposes of this test. However, if the ratio of the emission rates is not within these limits for either pollutant, the program terminates operations on that source, prints the following data, and begins operating on the next source:

(Source ID Number) - fuel data error - E_j = (Calculated Emission Rate)

e_j = (Input Emission Rate)

After making these calculations, the program begins application of specific fuel substitution measures.

5.4.3.2 Specific Fuel Substitution Measures

The program contains three fuel elimination methods (Devices 027, 028, and 029) and three fuel sulfur content limitation methods (Devices 030, 031, and 032). The fuel elimination methods are primarily intended to control particulate emissions and as a result, are likely to yield misleading results if applied to sulfur oxides emissions.

The operational characteristics of the fuel substitution measures are as follows:

(a) (Device 027) Elimination of Coal

This method converts any coal which a source may be burning to residual oil, distillate oil, or natural gas with an equal or lower sulfur content. If the source is not burning coal (i.e., $B_C = 0$), this method is inapplicable and the program moves to the next control method. If the source is burning coal (i.e., $B_C \neq 0$), the program examines the alternate fuel information in the regional data, and picks the grade of residual oil with the highest sulfur content less than or equal to the sulfur content of the coal being replaced. In the event there is no residual fuel oil in the region data input which satisfies the above requirements, the program will examine distillate oil and attempt, in the same manner as above, to select an alternate fuel. If no distillate oil is available which meets the requirements, the program switches to natural gas (if available) as the only possible alternate fuel. If gas is not available, the program moves to the next control method. In this case the program prints an error message to the effect that the specified fuel substitution could not be made. The quantity of new (substituted) fuel needed is determined by the requirement that the usable heat input (BTU/hr) must remain unchanged after the fuel substitution.

(b) (Device 028) Elimination of Coal and Residual Oil

This control method operates in the same manner as Device 027, except that the first fuel switch attempted (from coal and residual oil) is to the proper grade of distillate oil.

(c) (Device 029) Elimination of Coal and All Fuel Oil

This control method operates in the same manner as Device 027, except that all existing fuels are switched to gas.

(d) (Devices 030, 031, 023) Fuel Limitation Based on Maximum Allowable Sulfur Content

The three fuel sulfur content limitation methods differ only in that a unique set of allowable sulfur content levels may be input for each method. For each method, an allowable sulfur content for coal, oil and gas must be input.

The program is designed to replace existing high sulfur content fuels with lower suflur content fuels (of the same type if possible) taken from the input region data base. For the program to perform realistic fuel (or fuel grade) switches the user must insure that the input alternate fuel data and the input fuel sulfur limitation values are compatible. Failure to do so is likely to result in the program simulating unnecessary fuel switches that would not be resorted to in practice. If this occurs, the cost and emission data produced by the program will be misleading.

The basic series of steps followed by the program for assigning fuel usage under the various sulfur limitations are outlined below:

(1) Each existing fuel being burned is examined to determine if the specified sulfur limitation is exceeded.

(2) If the limit is exceeded, then a search is made of the regional data base for a fuel of the same type (i.e., coal, residual oil, etc.) having the proper percent sulfur.

(3) If no fuel of the same type meets the requirements, then alternate fuel types are considered. Alternate fuel types are examined in the following order until a suitable fuel is found: Residual Oil (grades 1 through 5), Distillate Oil (grades 1 through 3), and Natural Gas. The user should note that switching fuel types will change the maximum allowable sulfur content (since a separate allowable content for each fuel type is input).

5.4.3.3 Fuel Substitution Computations

After a suitable fuel grade has been determined, the program carries out a series of calculations leading to the determination of the cost and the various fuel use and emission parameters. The first step is to compute the amount of each new fuel required. This is accomplished through use of the annual cost (P_i) and annual BTU contribution (B_i), as calculated in Subsection 5.4.3.1. The specific procedure for the fuel elimination and sulfur content limitation methods are as follows:

Devices 027, 028, 029

For these devices, the total usable heat produced by the eliminated fuels (B_i,i = C and/or R and/or D) must equal the total usable heat produced by the substitute fuel (B_{Ni},i = R or D or G), i.e.,

$$\sum B_i = B_{Ni}$$

Substitute fuels are sought having the same or lower sulfur content as the fuel to be eliminated. If these requirements cannot be satisfied for a given fuel substitution, the program will attempt to meet the conditions with a more costly fuel substitution (e.g., for device 027, if residual oil is not acceptable switch to distillate oil is attempted).

Devices 030, 031, 032

For the sulfur limitation methods, a number of fuels may be eliminated in favor of a number of others, but the substitutions are made on a one-for-one basis so that the usable heat produced by an eliminated fuel will be exactly matched by the usable heat produced by the corresponding substitute fuel, i.e.,

$$B_{Ni}\ (i=C,R,D,\text{ or }G) = B_i\ (i=C,R,\text{ or }D)$$

The process is repeated unti the requirements are met or the fuel types available for substitution are exhausted, in which case the program will print a message to the user and go on to the next control method (device) in the table.

The amount(s) of new fuel(s) is then determined from the following equation:

$$A_{Ni} = \frac{B_{Ni}}{H_{NC}\ (\text{Boiler Eff.})_i} \quad (i = C,R,D,\text{ or }G)$$

The annual cost of each new fuel is then computed as

$$P_{Ni} = A_{Ni}\ C_{Ni}.$$

Summing P_{Ni} for all new fuels used gives the total annaul cost of the fuel(s). The annual costs of the fuels to be eliminated (P_i) are then summed. The total additional annual fuel cost (C_{add}) is the total new fuel sum minus the total old fuel sum.

The new (controlled) emission rates are now calculated by use of the following equations:

$$\begin{aligned} e_{NS} = \Big[\frac{e_S}{1-D_S} &- E_S + (5.2\ A_{NC}\ S_{NC}\ 10^{-5}) \\ &+ (21.5\ A_{NR}\ S_{NR}\ 10^{-8}) + (17.7\ A_{ND}\ 10^{-8}) \\ &+ (5.5\ A_{NG}\ 10^{-13})\Big]\ (1 - D_S) \end{aligned}$$

$$e_{NP} = \Big[\frac{e_P}{1-D_P} - E_P + (1.37\ A_{NC}\ a_N\ f_1\ 10^{-6}) +$$

$$+ (1.37\ A_{NR}\ f_2\ 10^{-9}) + (1.37\ a_{ND}\ f_2\ 10^{-9})$$

$$+ (1.37\ A_{NG}\ f_2\ 10^{-12})\Big]\ (1 - D_p)$$

The decimal efficiencies of the control method are calculated from:

$$D_{NS} = 1 - \frac{e_{NS}}{e_S}\ ;\ D_{NP} = 1 - \frac{e_{NP}}{e_P}$$

The final calculations for the fuel substitution methods consist of: (1) summing the total fuel, by fuel category, used by the source after application of each method and (2) for devices 030, 031, and 032, calculating the sulfur dioxide allowable emission rate.

The sulfur dioxide allowable emission rate for devices 030, 031, and 032 is based upon the existing source emissions and upon the existing and allowable sulfur content. If a source already uses fuel with a sulfur content at or below the allowable levels then the allowable emission rate is set equal to existing emissions. If sulfur content levels higher than the maximum allowable are being used then the following computation is carried out for each fuel type.

$$\text{Allowable Emission}_i = \text{Existing Emission}_i\ \frac{\text{Allowable Sulfur Content}_i}{\text{Existing Sulfur Content}_i}$$

where the existing emission rate used in this equation represent the emissions from a particular fuel type. These allowable emissions are then summed by fuel type to provide an overall allowable source emission rate under the sulfur content limitation specified by the control measure.

5.5 PROGRAM OUTPUT

The Control Cost Program produces output in printed table form and on magnetic tape. The magnetic tape output, defined as the Control Cost File, is used by the Emission Standards Program. Both types of output contain the same information. As a result, the tabular data may be used to verify the Control Cost Program results before proceeding with the Emission Standards Program run. Example computer generated output for the Control Cost Program is presented in Subsection 7.5.

The program table output consists of the following:

- Regional Data

  The Regional Data Table displays those user input parameters which describe regional economic and fuel availability conditions. This table provides a convenient reference for selection of sulfur limitation standards in the Emission Standards Program.

- Device Data

  This output displays the control device data used during the Control Cost Program run. These data may be either pre-set or user generated input values. The table lists all the devices available for application in the Control Cost Program together with their efficiencies, cost information and operating characteristics. This table provides a convenient reference to use if apparently incorrect values are calculated in the application of particular control devices.

- Device Applicability Criteria

  If the user has included source types other than those fixed in the program (see Table 5-3), an output is provided displaying the added source types. This output consists of SIC code and process number for each new source along with an indication of which control devices may be applied to this source.

- Control Cost Data

  The basic output data generated by the Control Cost Program consists of both calculated data and unaltered data from the Source File. For each source a line of unaltered data is printed (ID line) and a line of data (DEV line) for each applied device is printed.

  The Source ID line consists of the existing data: emission rates, device efficiency, rated capacity and maximum process weight, fuel heat contents, and plant parameters (shifts and use factor. The DEV lines (containing data resulting from application of each device) consists of device identification, efficiency (both pollutants), resulting exist gas temperature and volume, total annualized costs, operating and maintenance cost, cost effectiveness figures, and fuel use rates after device application. A flag is also shown to indicate if gas cooling has been used. The first device considered is always the existing device, represented by a device identification of 0. (This does not reflect the existing device identification number input to the Source File). Therefore, the first printed line under the DEV line is also data taken directly from the Source File.

5.6 THE CONTROL COST FILE UPDATE PROGRAM

The data on the Control Cost File, created by the Control Cost Program, may be reviewed by the user through the table outputs described in the previous subsection. In addition, a NAMELIST dump of the file contents may be obtained through the use of the Control Cost File Update Program. If errors or omissions are detected which may be corrected the existing file may be updated through use of the update program. This program is written in the FORTRAN language and allows the user to update any Control Cost File record. However, the update capability is limited in that no record may be deleted entirely and no new record may be added to the file. It is anticipated that extensive changes of this type would require the user to rerun the Control Cost Program. Subsection 7.6.3 gives the detailed input and output specifications for the update program.

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6.0 CONTROL STRATEGIES SEGMENT

6.1 PURPOSE

The basic function of the implementation Planning Program is to determine the effects of various regional air pollution control alternatives on source emission rates, control costs and ambient air quality levels. This capability is exercised through application of the Control Strategies Segment, which brings together the economic and technical estimates generated by the Control Cost Segment and the regional pollutant dispersion information produced by the Air Pollutant Concentration Segment.

The Control Strategies Segment can be used to simulate the enactment of a variety of emission standards for particulate matter and sulfur dioxide. Provision is made for each political jurisdiction within the region to select a set of emission standards independently of other jurisdictions. As a result, realistic simulations of legislatively possible and politically feasible air pollution control effects are possible.

The Control Strategies Segment consists of the three separate programs; Emission Standards Program, Emission Standards File Update Program, and Regional Strategies Program. These programs are designed to be run as separate job steps.

The operation of this segment begins with the use of the Emission Standards Program to apply candidate emission standards to the point sources within each political jurisdiction. The candidate emission standards are selected, by the user, from a list of standards types fixed in the program. The point source characteristics (obtained from the Control Cost File) which comply with these standards are then output on the Emission Standards File for use by the Regional Strategies Program.

If the user desires to apply emission standards types or control devices not considered by the program, the appropriate application data (user generated) must be added to the Emission Standards File. The modification of this file is accomplished with the Emission Standards File Update Program.

After the Emission Standards File is judged to contain all necessary data, it is used by the Regional Strategies Program to construct the candidate emission control strategies. For each strategy, the program summarizes the resulting source and device characteristics on both a political jurisdiction and a regional basis. Summary tables are given for existing emission rates, allowable emission rates (based on the applied emission standards), controlled emission rates (resulting from control device application required for emission standard compliance), and annual cost of control. In addition to the emission rate and cost summaries, new air pollutant concentration values are computed. The calculation of the new concentration values is accomplished through use of the Source Contribution File (the Air Pollutant Concentration Program need not be re-executed) and is based on existing or allowable emission rates, whichever is less. Emission control effects on area sources is accounted for by user input scale factors. The scaled area source emission rates are included in the summary tables and are used during calculation of the new air quality.

The user may also obtain emission rate summaries and new air quality for future (projected) time periods. This is accomplished by input projection factors for each source (both point and area) in the region. These factors are used to project both the existing and allowable emission rates resulting from a selected strategy.

6.2 EMISSION STANDARDS PROGRAM

6.2.1 Emission Standards Input

The Emission Standards Program utilizes data from the Control Cost File and punched card input. The punched card input specifies the region identification and the particular emission standards to be applied. Section 7.7 gives the input and operating procedures for this program.

6.2.1.1 Control Cost File Data

The basic calculations of the device application costs and efficiency data are made within the Control Cost Program (Chapter 5). These calculations are carried out for each point source identified in the Source File. The exact items which are output on the Control Cost File are described in Section 7.6. In general, this file contains the source and device characteristics resulting from utilizing each applicable control device and method (contained in the Control Cost Program) with each point source identified in the region (computations and criteria used in assigning device applicability are described in Chapter 5). This file also contains the existing source characteristics, as defined by the Source File. For each point source then, the Control Cost File contains data for all available control alternatives which can be used in attempting to meet the various emission standards. The file data includes the following items:

(a) Source Identification - Each source-device combination is identified by SIC, site and process code, political jurisdiction, and source type. This identification is necessary since the emission standards are applied on a source category-political jurisdiction basis.

(b) Source Parameters - The source parameters required for emission standards application are included (emission rates, maximum process rates, heat output, etc.).

(c) Control Efficiency - The efficiency of each control device or measure represents the degree of pollutant removal expected as a result of applying a control device to a particular source. The removal efficiencies, expressed as percentages, are given for particulates and sulfur dioxide.

(d) Device Costs - The total annual cost is given for each source-device combination. The figure includes both an annual capital charge (based on the purchase and installation costs) and yearly operation and maintenance expenses. On the basis of the data from the Control Cost File, the Emission Standards Program selects, for each source, the least costly method of meeting the various emission standards.

(e) Miscellaneous Information - Several types of information are included in the Control Cost File which are not used by the Emission Standards program. However, this information is utilized by the Regional Strategies Program, which communicates with the Emission Standards File but not the Control Cost File. As a result, the Miscellaneous Information is simply "passed through" the Emission Standards Program to the Emission Standards File. This information consists of:

- Fuel use data - the quantity of each type of fuel used by each source after control. These quantities are required for use in the "fuel used" tabulations in the Regional Strategies Program.

- Gas cooling indication - this indicator allows each source utilizing gas cooling to be identified in the Regional Stragetics Program output.

6.2.1.2 Punched Card Data

Punched card input consists of the region identification, run date and specification of the emission standards to be applied.

The program has a number of emission standard types (Table 6-1) whose application is controlled by user input. Each standard type has pre-set curve coordinates (or other fixed parameters) which will be used by the program unless the user inputs new data. The Type column listed in Table 6-1 indicates the basic format for each emission standard. For instance, "Heat Input" indicates that the amount of pollutant a combustion source may release is based on the quantity of heat energy input to the source (i.e., its allowable emission rate). The input variables shown for each standard are those which the user may adjust to suit the specific conditions and requirements of the political jurisdiction to which the standard is applied. The pre-set values of these variables are given in Section 7.7. Figures 6-1 through 6-17 illustrate the pre-set curves. The "curve coordinates" notation in the Input Variables column of Table 6-1 indicates that any curve may be used as long as it can be represented by a series of connected straightline segments on log-log paper. For example, any emission standard based on heat input, process weight, or potential emission may be evaluated by the program.

For each source category (fuel combustion, industrial process or solid waste) - political jurisdiction (up to 10) - pollutant (sulfur dioxide or particulate matter) combination, the user selects the emission standards to be applied. For each of these combinations, any number of the emission standards shown in Table 6-1 may be specified. However, for a particular combination, each emission standard may be specified only once. As detailed in the remainder of this section (and in Section 7.7) some of the emission standards are not applicable to every source category-pollutant combination. Therefore, it is recommended that the user review the applicability of the emission standards before making his selection.

TABLE 6-1

EMISSION STANDARDS

Standard Number	Type	Statement of Emission Standard	Input Variables
EST01	Null	No regulations applied	None
EST02	Maximum Technology	Use the most efficient device or measure available (from the Emission Standards File) for each source as determined by the Control Cost Program.	None
EST03	Maximum Technology	Same as No. 2 except that up to ten devices or measures can be excluded from available controls.	List of devices to be excluded.
EST04	Maximum Technology	Same as No. 2 except that up to ten devices or measures can be excluded from available controls.	List of devices to be excluded.
EST05	Potential Emission	Use Potential Emission Curve (Figures 6-1, 6-2) giving potential emission rate vs. allowable emission rate.	Curve coordinates
EST06	Potential Emission	Use Potential Emission Curve (Figures 6-1, 6-3) giving potential emission rate vs. allowable emission rate.	Curve coordinates
EST07	Potential Emission	Use Potential Emission Curve (Figures 6-1, 6-4) giving potential emission rate vs. allowable emission rate.	Curve coordinates
EST08	Heat Input	Use Heat Input Curve (Figures 6-5, 6-6) giving heat input vs. allowable emission.	Curve coordinates
EST09	Heat Input	Use Heat Input Curve (Figures 6-5, 6-7) giving heat input vs. allowable emission.	Curve coordinates

TABLE 6-1

EMISSION STANDARDS (Continued)

Standard Number	Type	Statement of Emission Standard	Input Variables
EST10	Heat Input	Use Heat Input Curve (Figures 6-5,6-6) giving heat input vs. allowable emission.	Curve coordinates
EST11	Heat Input	Use Heat Input Curve with Stack Height Limitation (Figures 6-8,6-9) giving heat input vs. allowable emission.	Curve coordinates
EST12	Effective Stack Height	Use Effective Stack Height Curve (Figure 6-10) giving effective stack height vs. allowable emission.	Curve coordinates, Met parameters
EST13	Exhaust Concentration	Stack gas concentration not to exceed a given value, in parts per million (ppm).	ppm value
EST14	Exhaust Concentration	Stack gas concentration not to exceed a given ppm limitation.	ppm value
EST15	Exhaust Concentration	Stack gas concentration not to exceed a given level, in grains per standard cubic foot (gr/scf). Two exhaust gas concentrations are specified for use above and below a certain source size which is also specified by a process weight value.	gr/scf values, process weight value
EST16	Exhaust Concentration	Stack gas concentration not to exceed a given gr/scf limitation.	gr/scf value

TABLE 6-1

EMISSION STANDARDS (Continued)

Standard Number	Type	Statement of Emission Standard	Input Variables
EST17	Exhaust Concentration	Stack gas concentration not to exceed a lb/1000 lb exhaust gas limitation.	lb/1000 lb value
EST18	Process Weight	Use Process Weight Curve (Figures 6-11, 6-12, 6-13) giving process weight vs. allowable emission.	Curve coordinates
EST19	Process Weight	Use Process Weight Curve (Figures 6-13, 6-14, 6-15) giving process weight vs. allowable emission.	Curve coordinates
EST20	Process Weight	Use Process Weight Curve (Figures 6-13, 6-16, 6-17) giving process weight vs. allowable emission.	Curve coordinates
EST21	Fuel Switch	Allows for elimination of specified fuels based on the numbering system; 1 = eliminate coal, 2 = eliminate coal and residual oil, 3 = switch to gas. (Only for particulate control).	Number of fuel switch desired
EST22	Fuel Switch	Allows for elimination of specified fuels based on the numbering system; 1 = eliminate coal, 2 = eliminate coal and residual oil, 3 = switch to gas. (Only for particulate control).	Number of fuel switch desired
EST23	Sulfur Content Limitation	Allowable sulfur content for each of three fuel types, (i.e., coal, residual fuel oil, distillate fuel oil) as input to regional data base for sulfur content limitation under Device 030.	None (Device 030 is applied)

TABLE 6-1

EMISSION STANDARDS (Continued)

Standard Number	Type	Statement of Emission Standard	Input Variables
EST24	Sulfur Content Limitation	Allowable sulfur content for each of three fuel types (i.e., coal, residual fuel oil, distillate fuel oil) as input to regional data base for sulfur content limitation under Device 031.	None (device 031 is applied)
EST25	Sulfur Content Limitation	Allowable sulfur content for each of three fuel types, as input to the regional data base for sulfur content limitation under Device 032.	None (Device 032 is applied)
EST26	Equivalent Fuel Sulfur Limitation	Allows use of flue gas desulfurization when emissions equivalent to those produced by a specified fuel sulfur content; 1 = equivalent sulfur content same as Device 30, 2 = equivalent sulfur content same as Device 31, 3 = equivalent sulfur content same as Device 32.	Number of fuel sulfur limitation desired

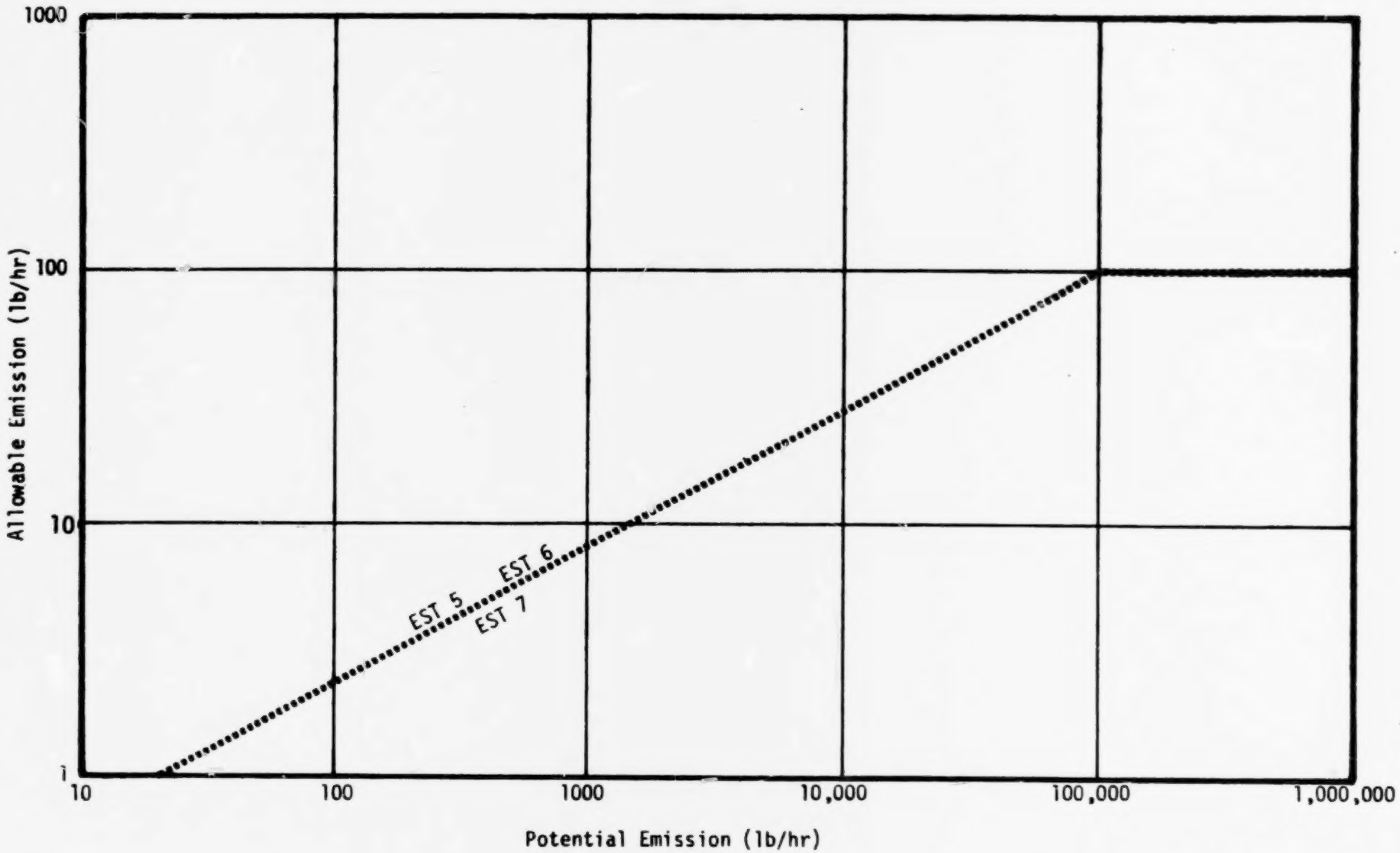


Figure 6-1. Allowable Sulfur Dioxide Emissions as Related to Potential Emission Rates (EST05, 06, 07).

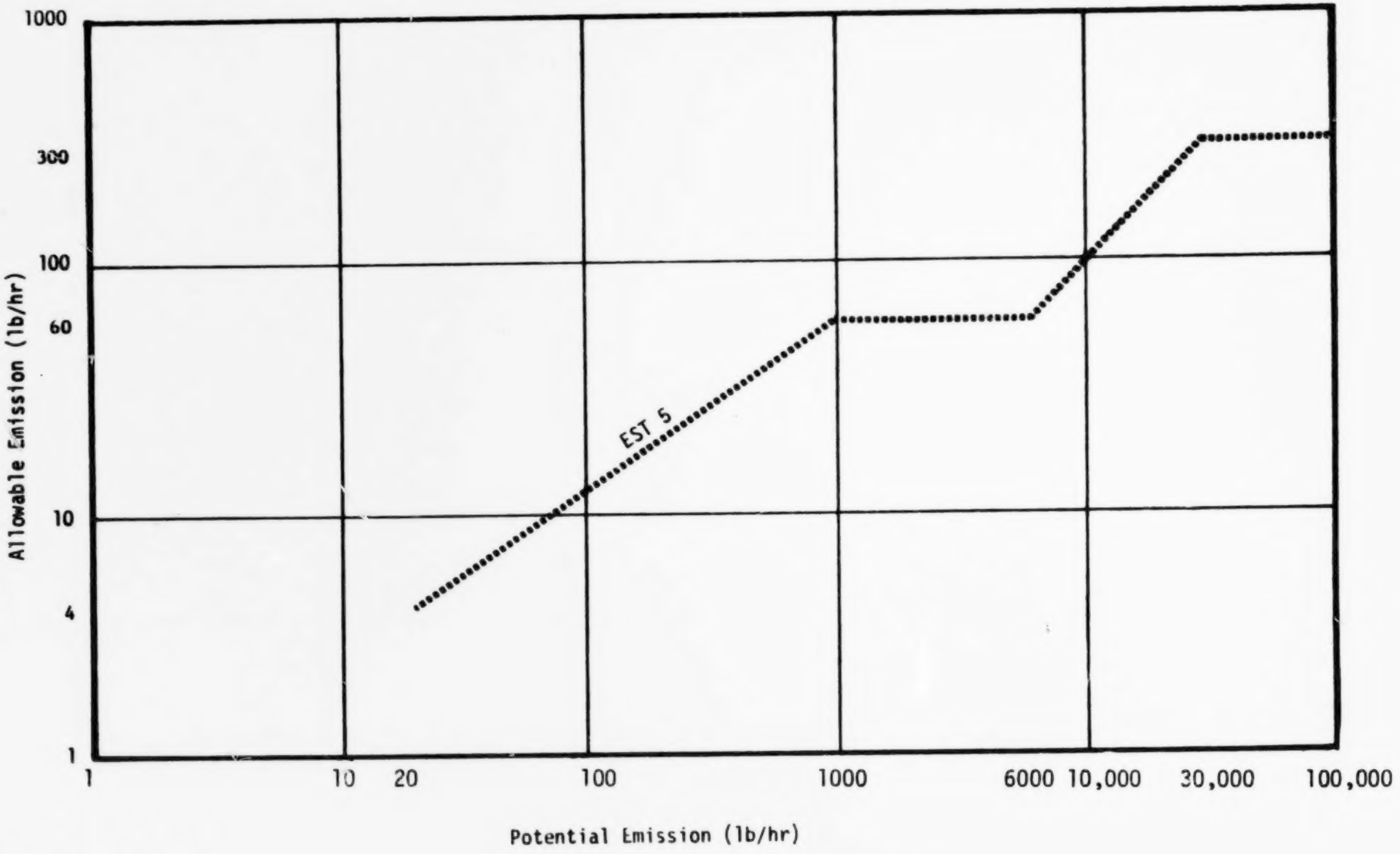


Figure 6-2. Allowable Particulate Emissions Related to Potential Emission Rates (EST05).

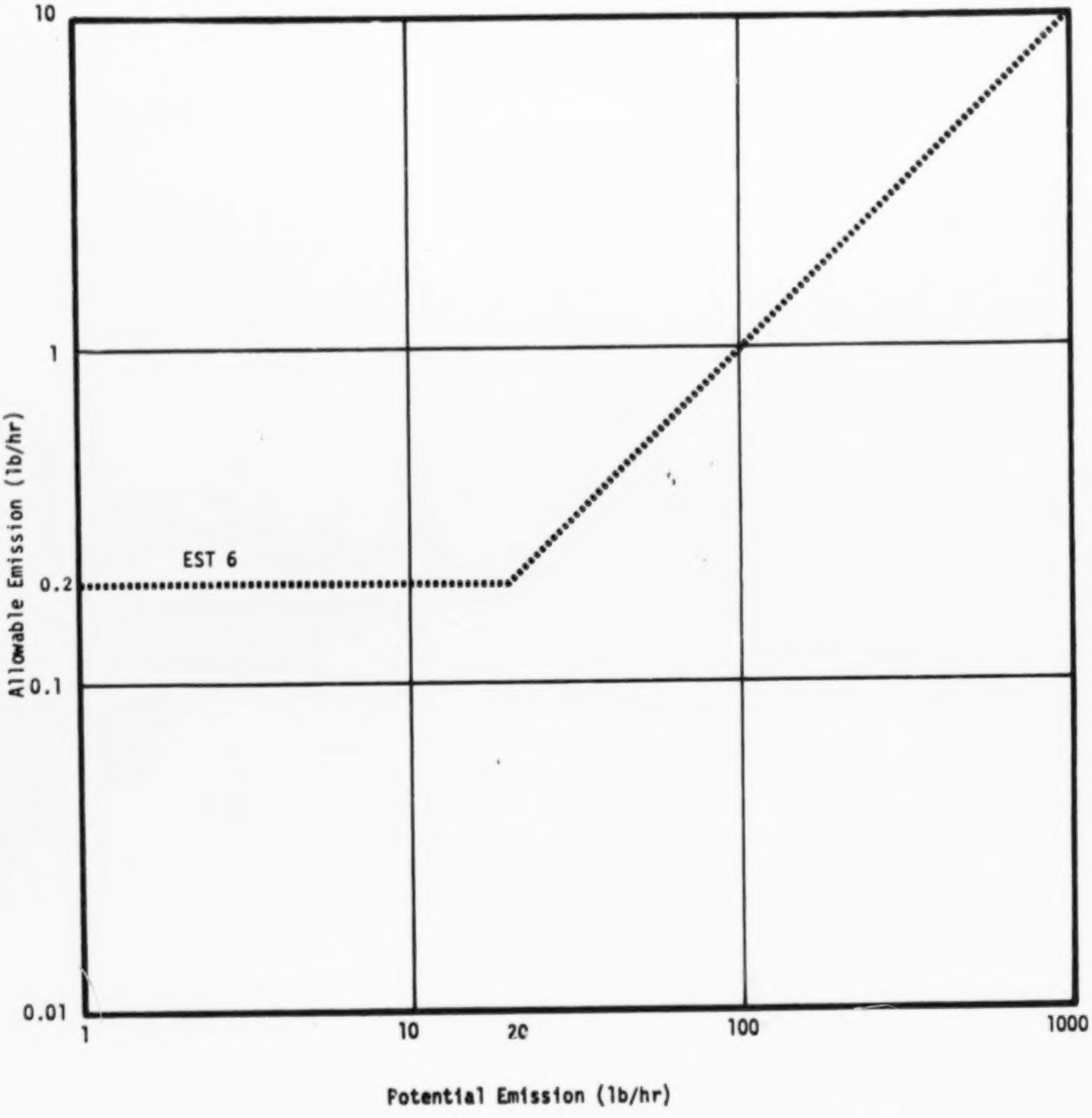


Figure 6-3. Allowable Particulate Emissions Related to Potential Emission Rates (EST06).

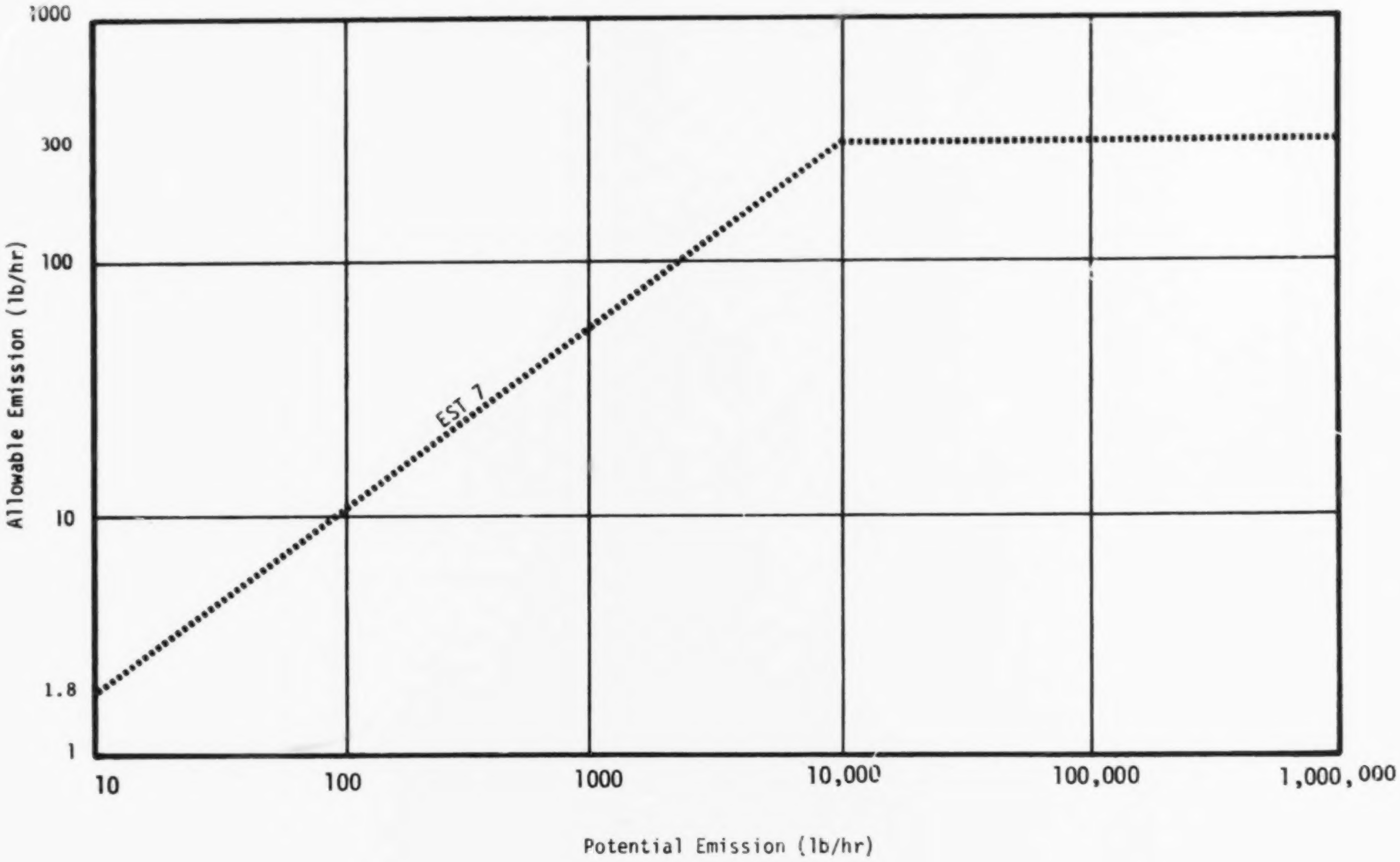


Figure 6-4. Allowable Particulate Emissions Related to Potential Emission Rates (EST07).

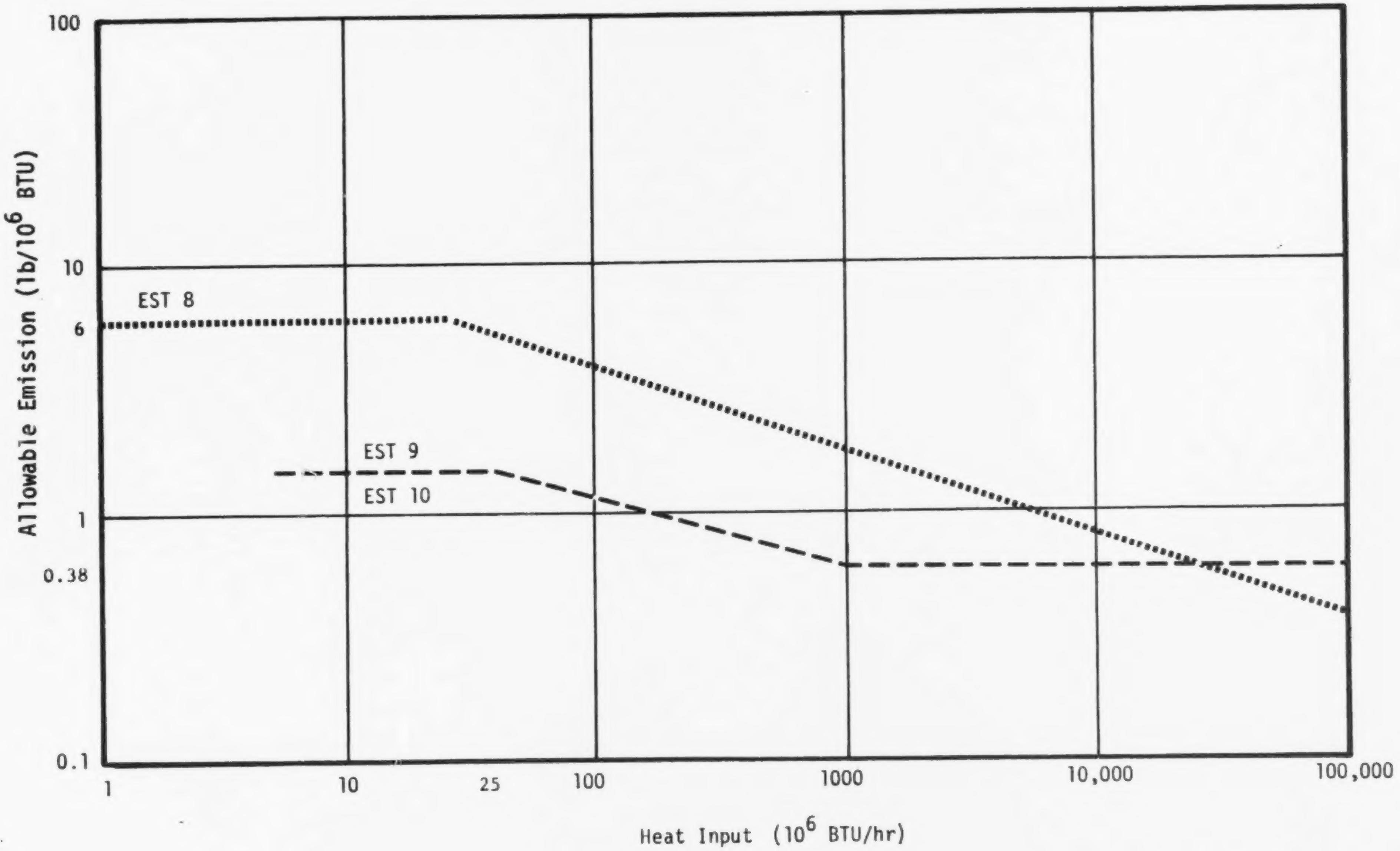


Figure 6-5. Allowable Sulfur Dioxide Emissions Based on Heat Input Capacity (EST08, 09, 10).

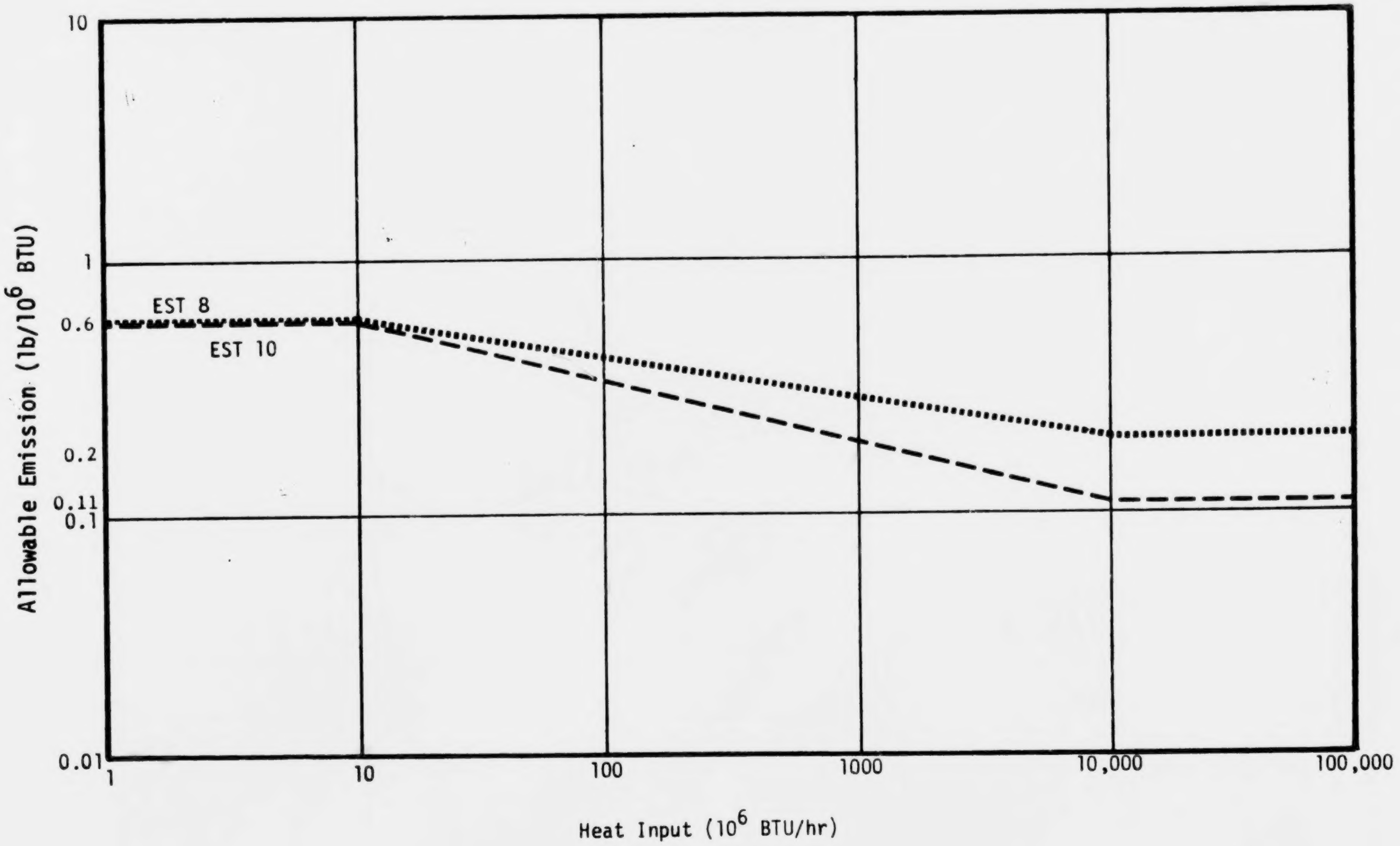


Figure 6-6. Allowable Particulate Emissions Based on Input Heat Capacity (EST08, 10).

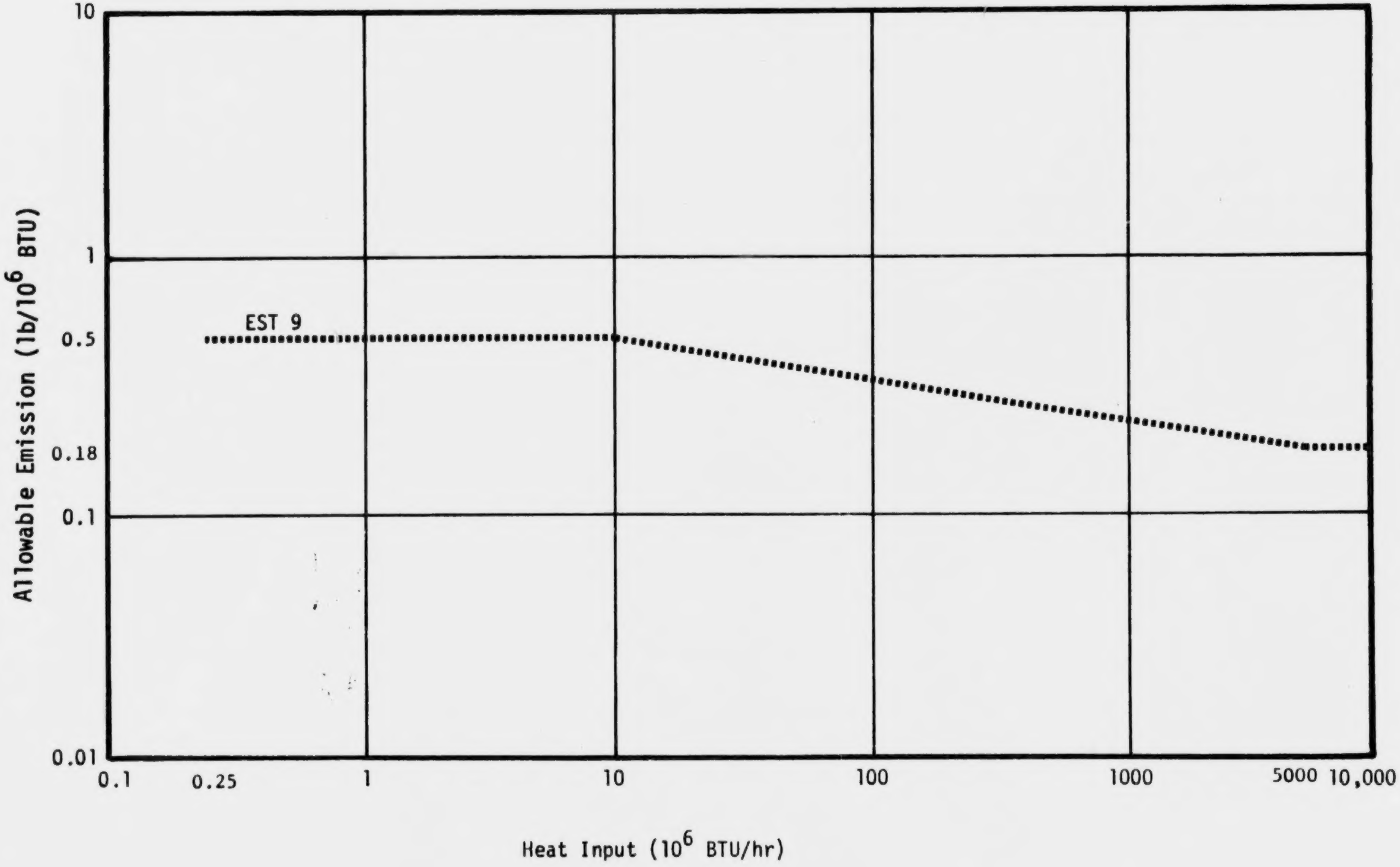


Figure 6-7. Allowable Particulate Emissions Based on Input Heat Capacity (EST09).

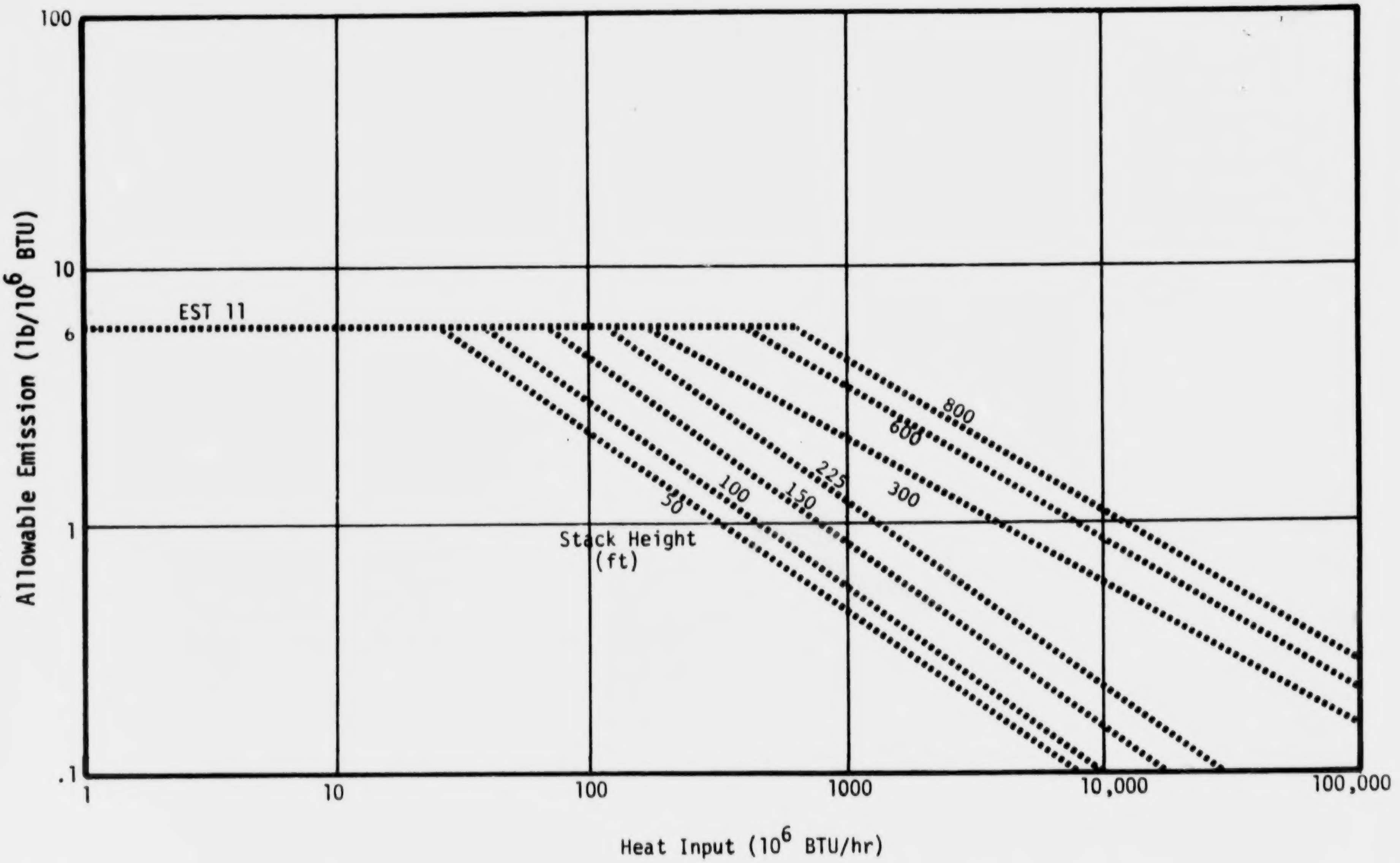


Figure 6-8. Allowable Sulfur Dioxide Emission Based on Heat Input and Stack Height (EST11).

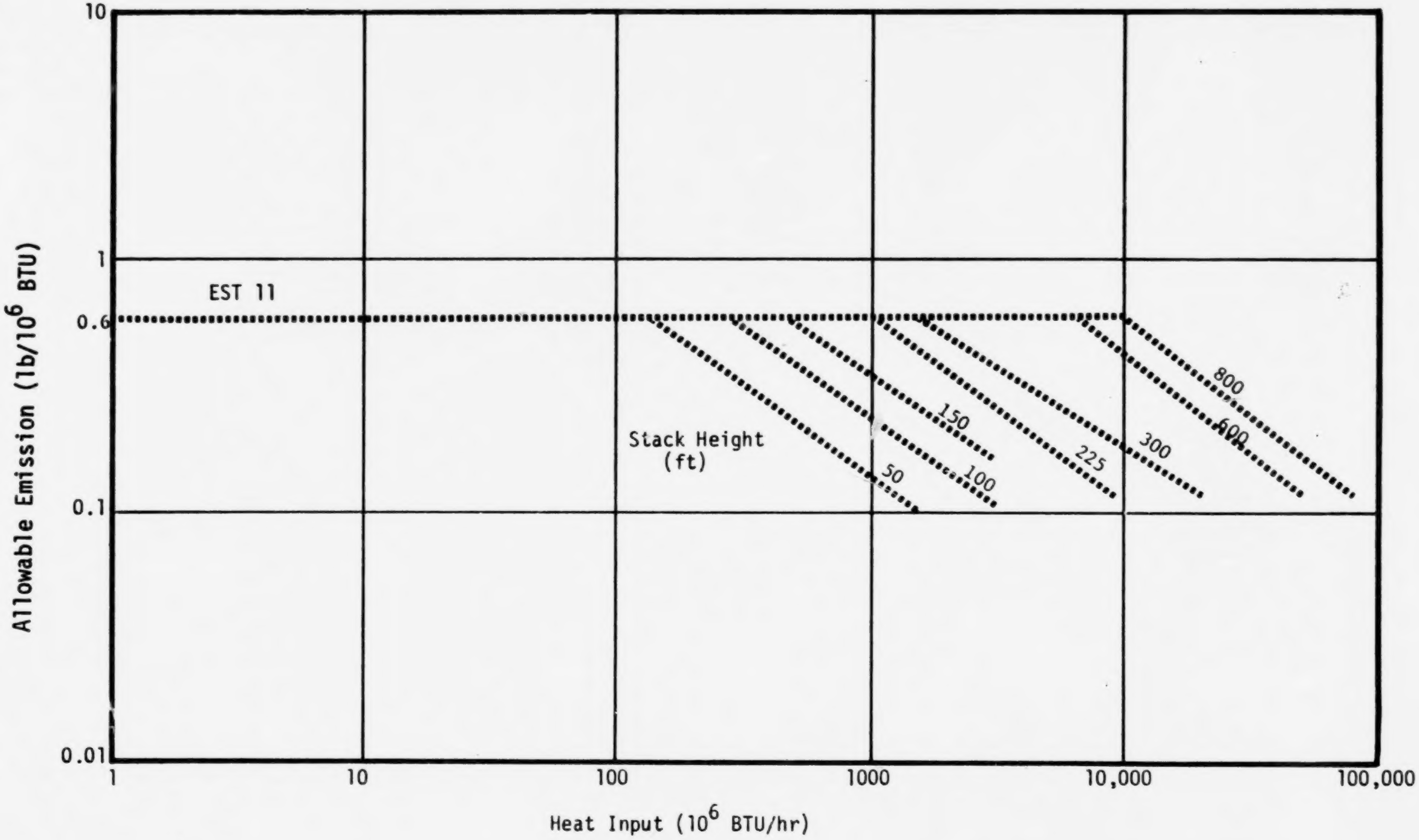


Figure 6-9. Allowable Particulate Emissions Based on Heat Input and Stack Height (EST11).

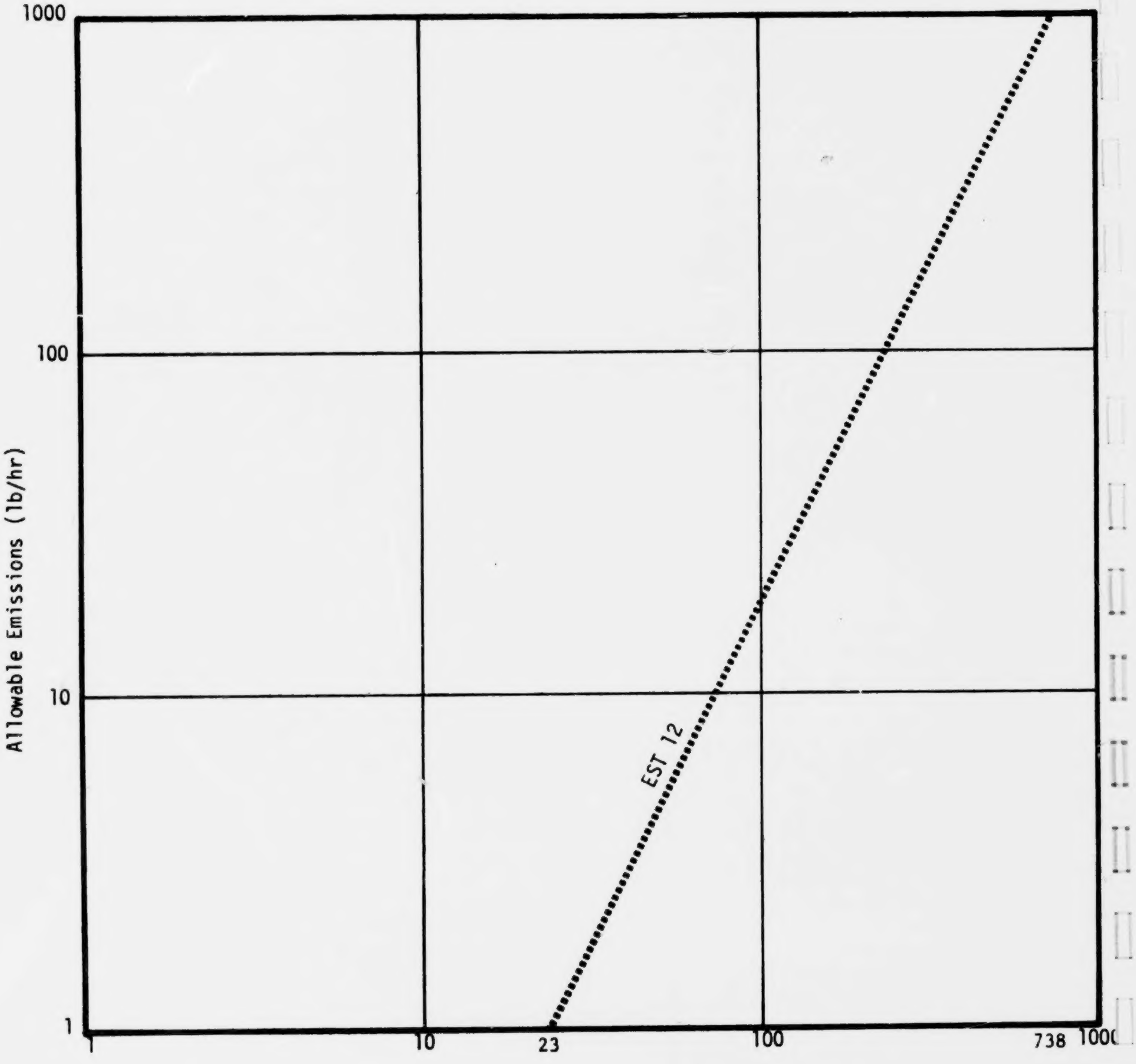


Figure 6-10. Allowable Particulate and Sulfur Dioxide Emissions Based on Effective Stack Height (EST12).

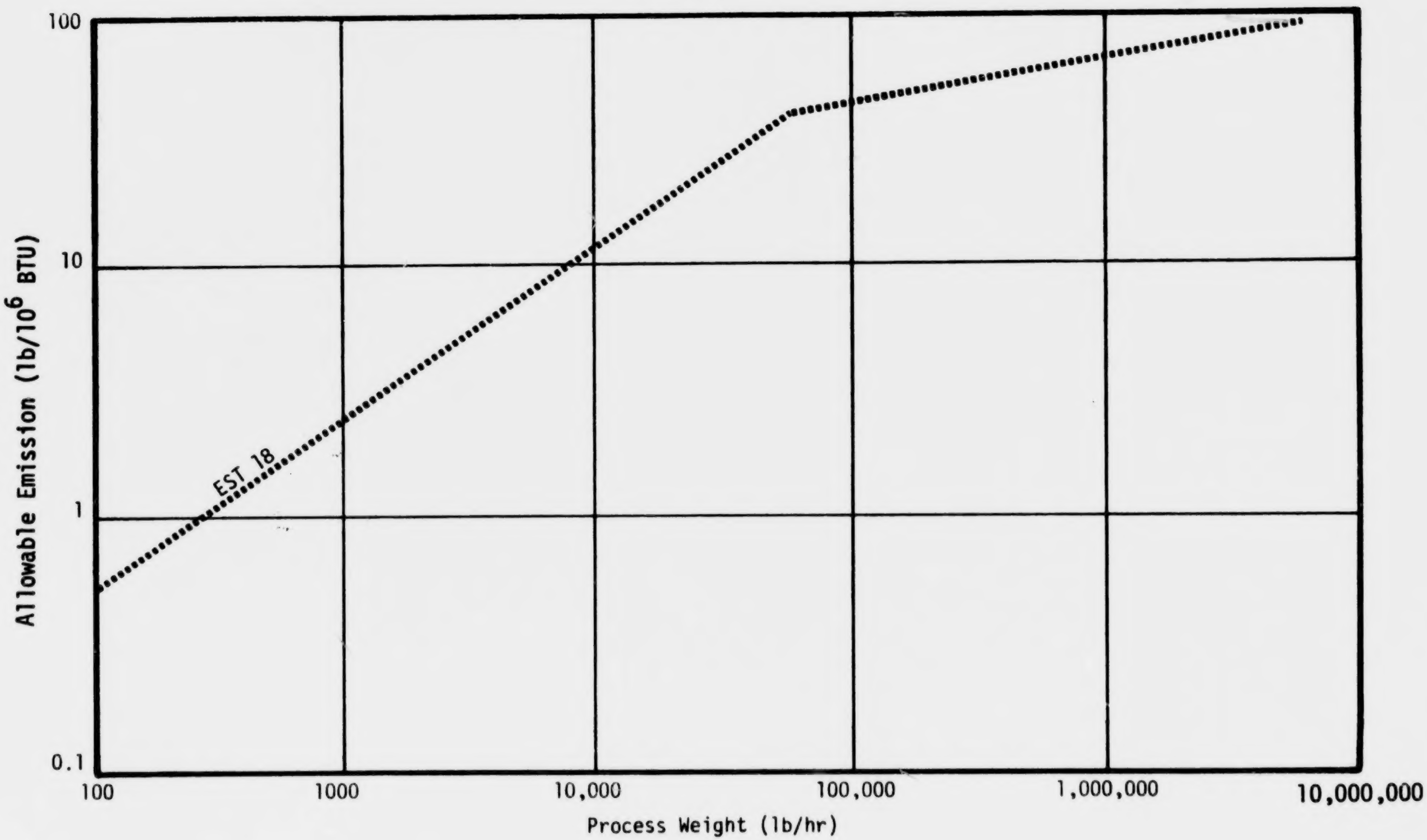


Figure 6-11. Allowable Particulate Emissions Based on Industrial Process Weight (EST18).

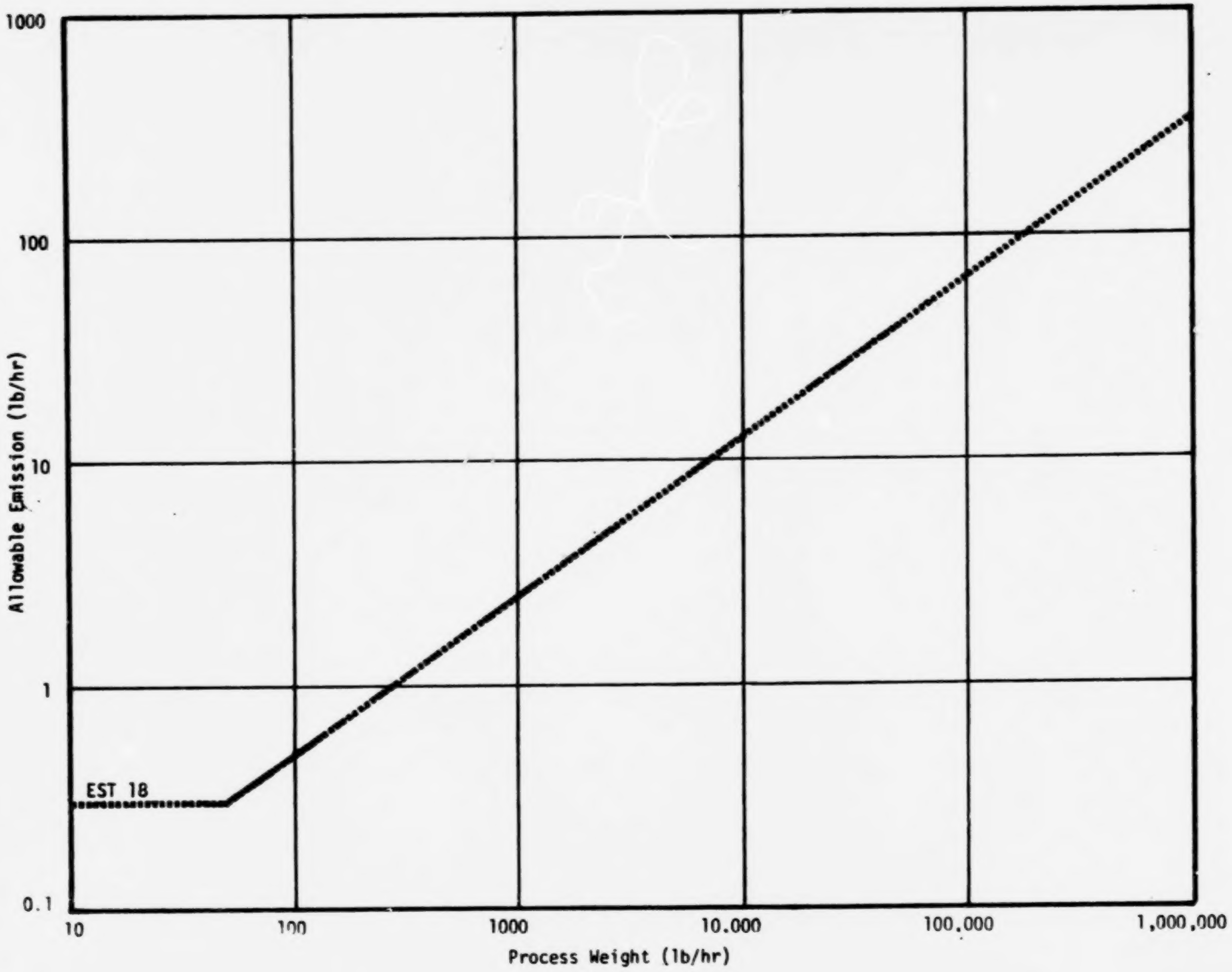


Figure 6-12. Allowable Particulate Emissions Based on Solid Waste Process Weight (EST 18).

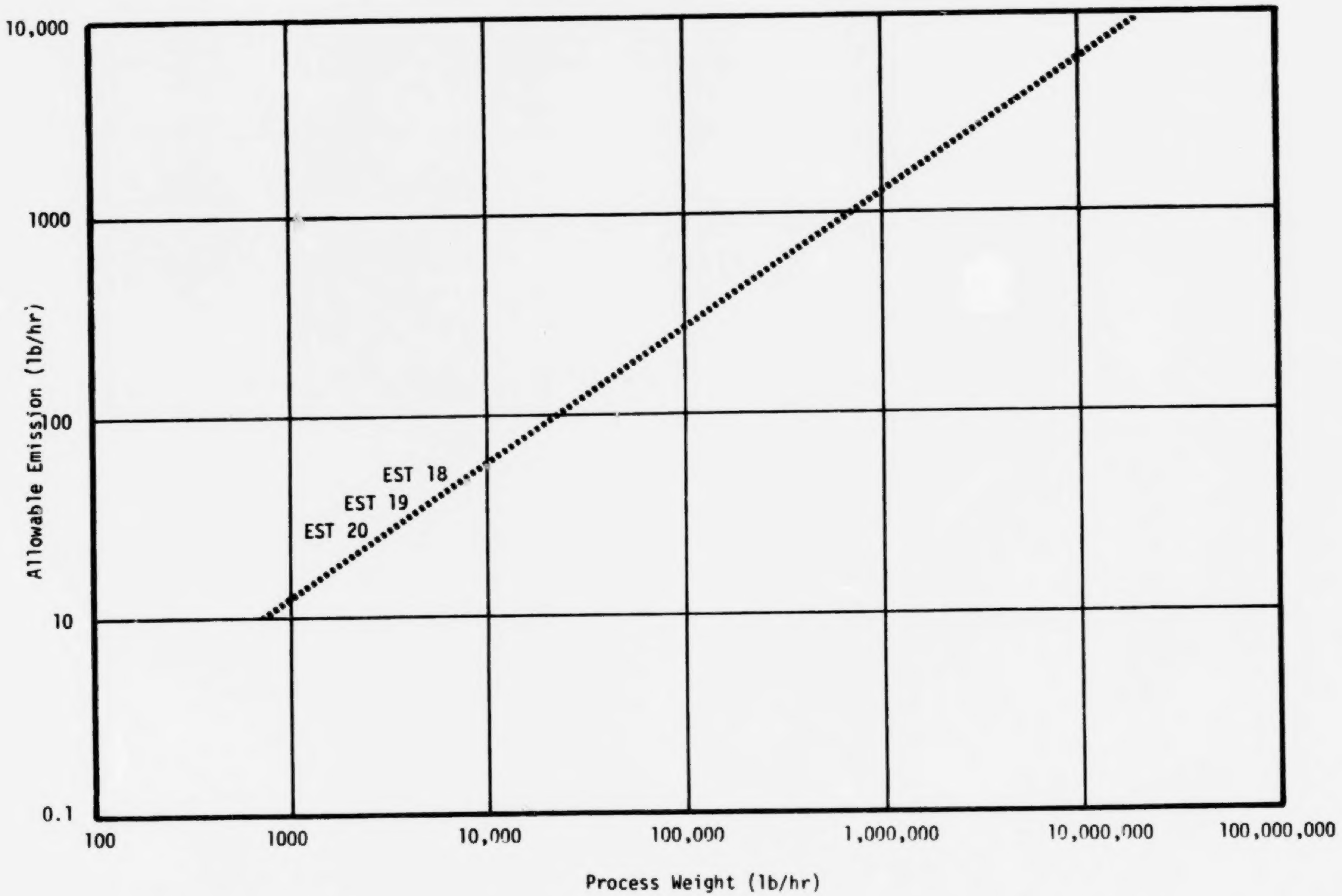


Figure 6-13. Allowable Sulfur Dioxide Emissions Based on Industrial Process Weight (EST18, 19, 20).

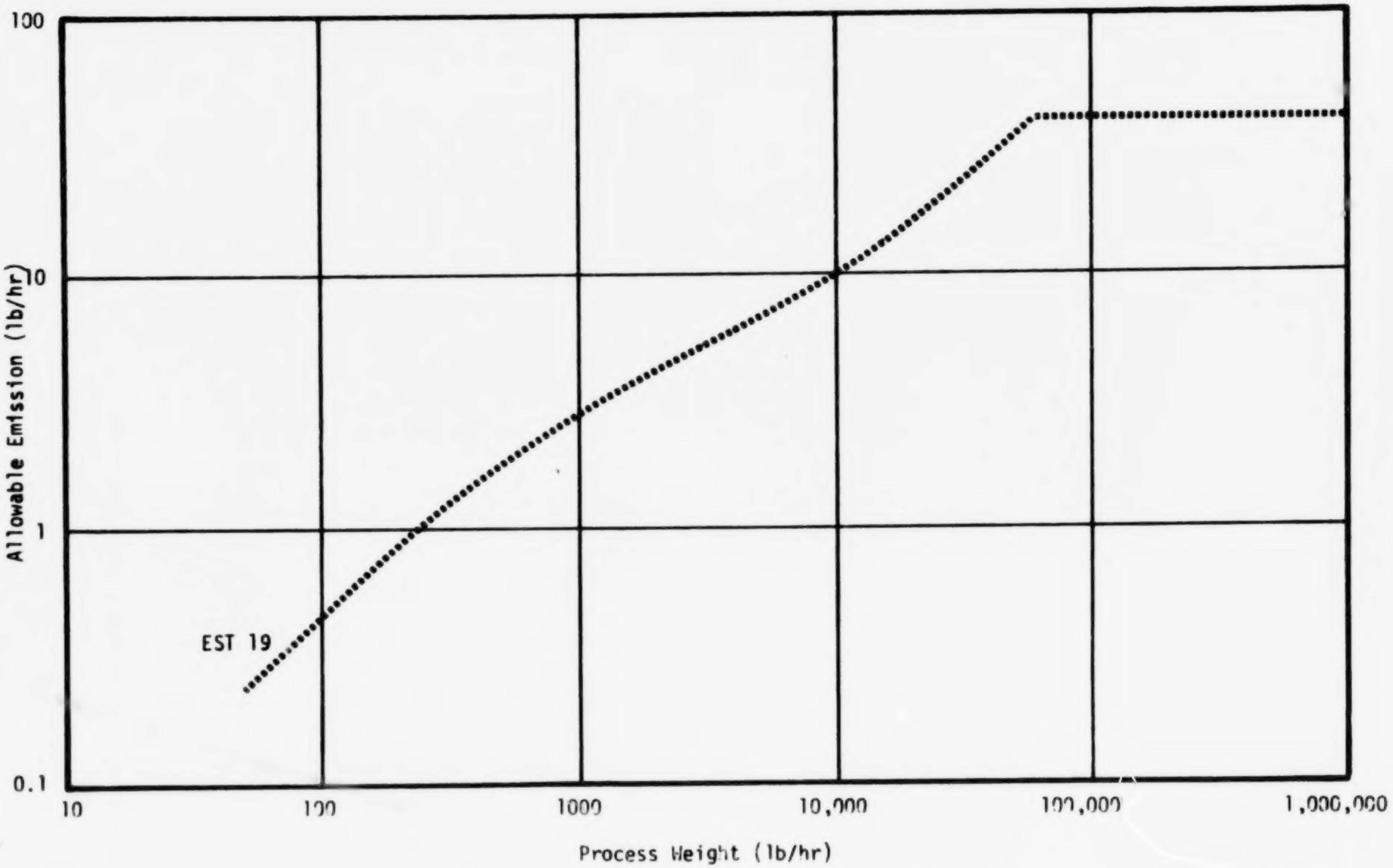


Figure 6-14. Allowable Particulate Emissions Based on Industrial Process Weight (EST 19).

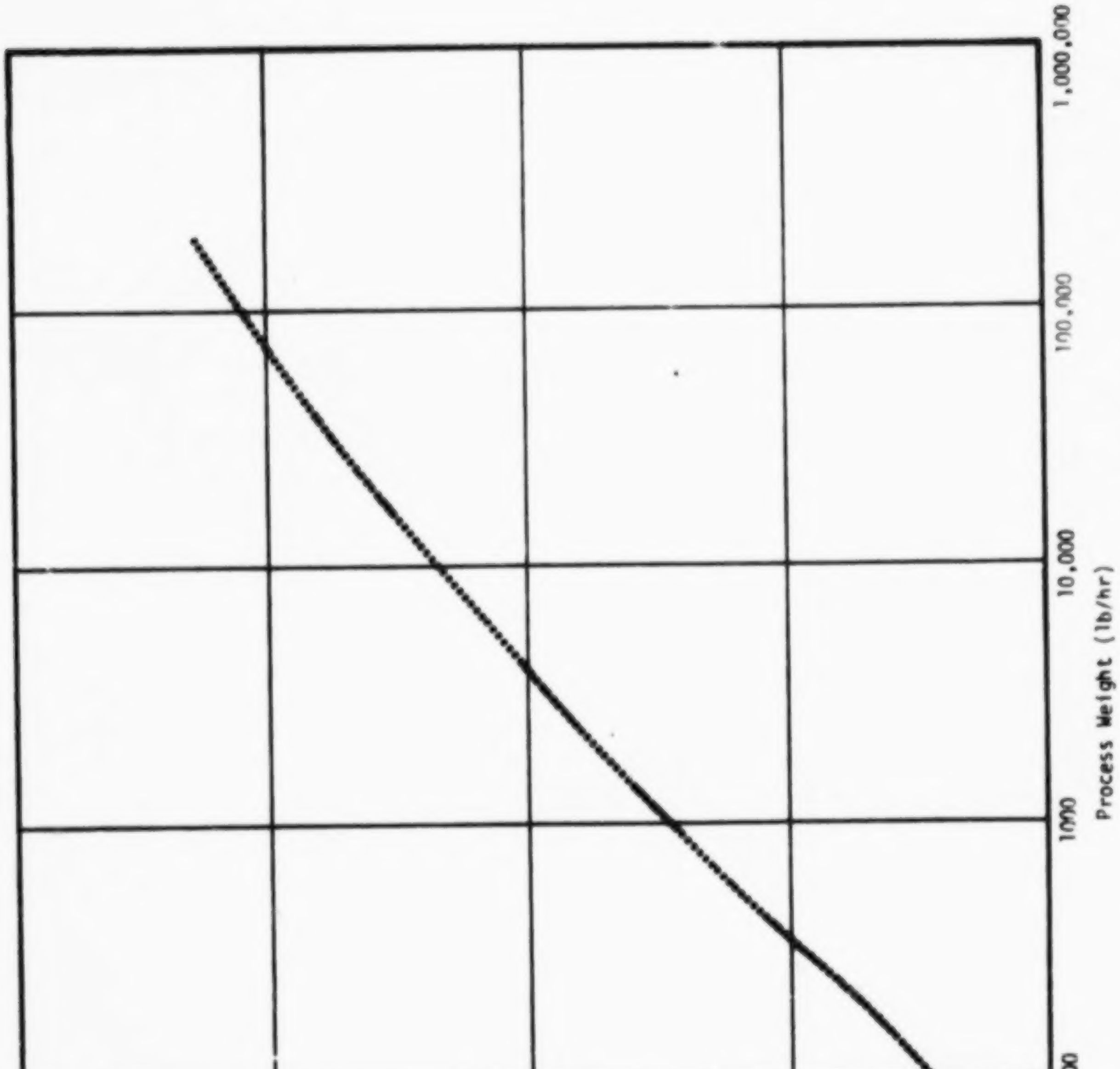


Figure 6-15. Allowable Particulate Emissions Based on Solid Waste Process Weight (EST 19).

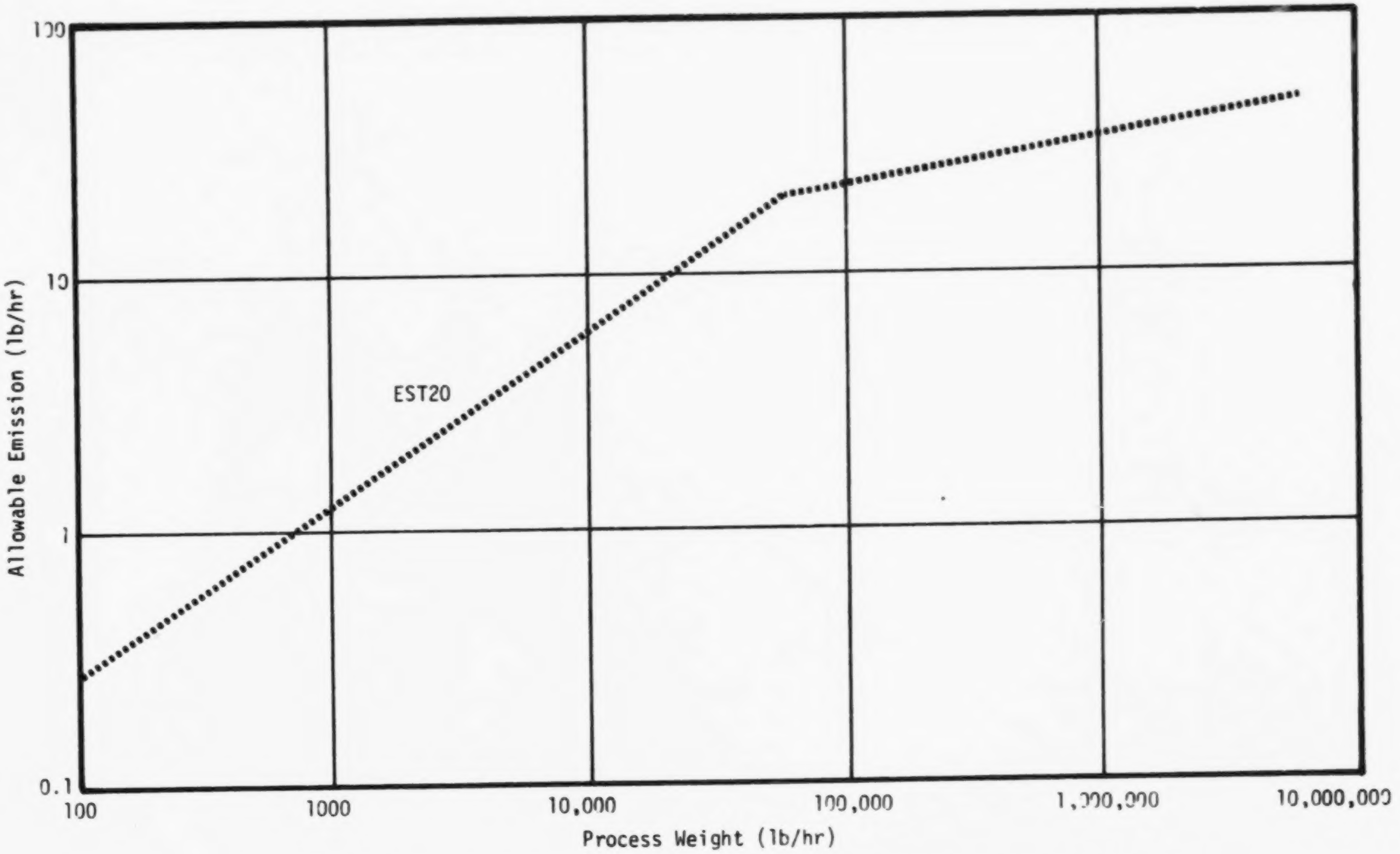


Figure 6-16. Allowable Particulate Emissions Based on Industrial Process Weight (EST 20).

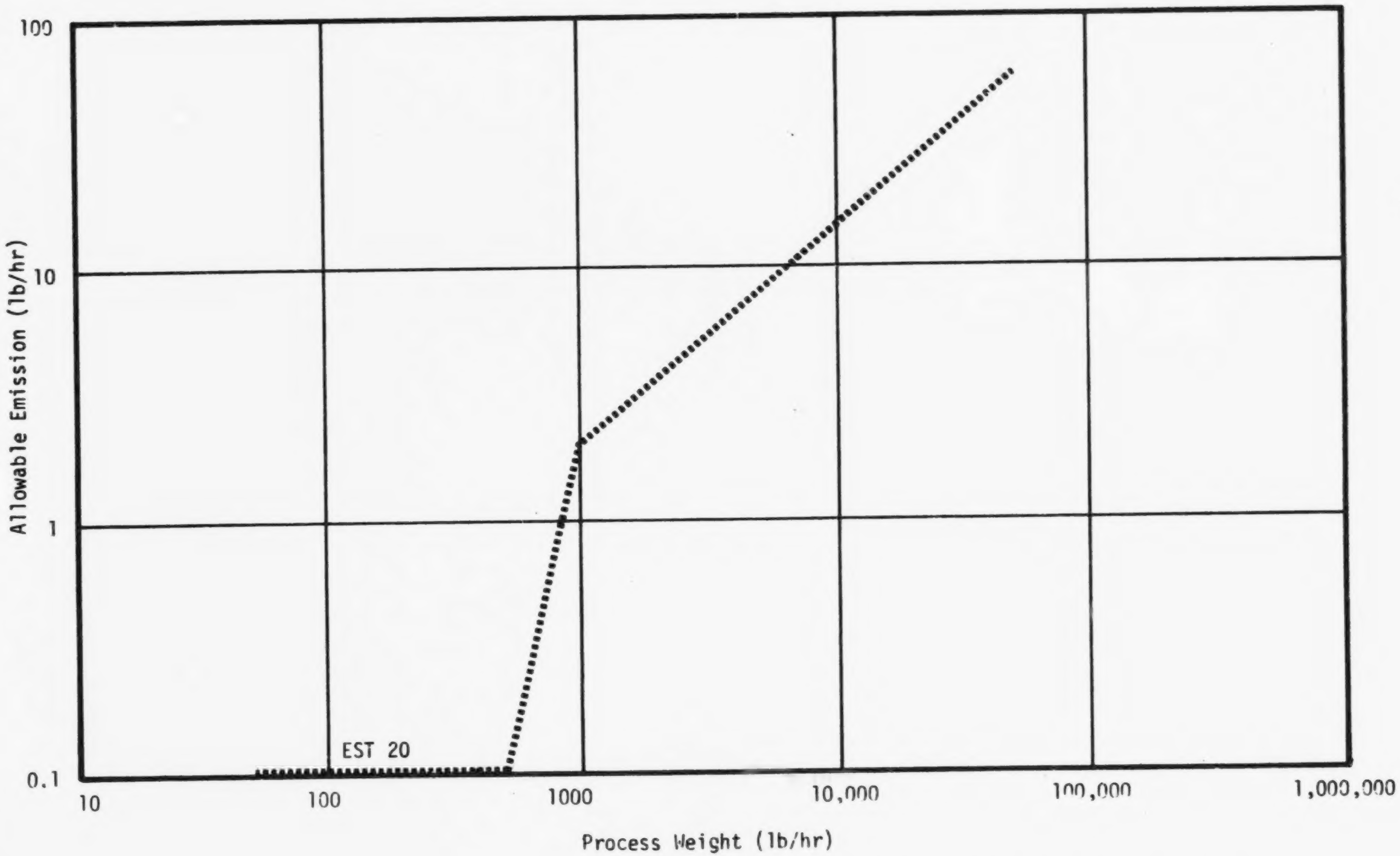


Figure 6-17. Allowable Particulate Emission Based on Solid Waste Process Weight (EST 20).

6.2.2 Emission Standard Program Operation

The Emission Standard Programs attempts to apply each specified emission standard to every point source that has the same source category-political jurisdiction-pollutant designation as the standard. For each candidate source, the allowable emission rate is obtained and, based on the control device information from the Control Cost File, an appropriate device (or method) is selected. Selection of the appropriate control device is based on the following tests:

(a) If the existing emission rate is less than the allowable emission rate, no device is chosen.

(b) If not (a) then apply the device which results in a controlled emission less than the allowable emission defined by the standard.

(c) If more than one device produces sufficiently low emissions, the device having the lowest annualized cost is selected.

When none of the available devices allows the sources to meet a particular emission standard, the most efficient* device is selected, and a flag is placed in the output record to indicate that the user should determine the availability of a more effective control device. If during application of an emission standard which employs a curve, the curve limits are exceeded, the program will proceed as follows:

(a) If the input variable to the curve exceeds the largest independent variable used in defining the curve, an error message will be printed and the standard will not be applied to that particular source.

(b) If the input variable to the curve is less than the smallest independent variable used to define the curve, a warning message will be printed and the allowable emission rate will be set equal to the existing emission rate of that particular source.

The operating sequence performed by the Emission Standards Program may be summarized as follows:

(a) All selected standards are applied to a particular source.

(b) All sources within a source category are handled as in (a).

---

*Based on pollutant removal efficiency.

(c) All categories within a political jurisdiction as in (b).

(d) All political jurisdictions within the region as in (c).

The description of each of the available emission standards (shown in Table 6-1) is given below.

For each emission standard applicable to solid waste-particulate matter sources (with the exception of EST01) an option is provided which allows the user to eliminate open burning sources during application of the standard.

- EST01 - Null Standard

  The first emission standard represents a null standard. That is, no changes in existing emission levels are required for the particular source category-political jurisdiction-pollutant combination specified by the user. If applied to each political jurisdiction, this standard may be used to provide a regional display of existing air pollution levels. It may also be used to test the result of certain control options which allow particular segments of the region (defined by their source type-political jurisdiction identification) to continue operating without additional emission restrictions. EST01 may be applied to all source category-pollutant combinations. Its region wide application is recommended since a summary of existing conditions provides a baseline from which to judge the effectiveness of the more restrictive control options.

- EST02 - Maximum Technology

  The second emission standard (EST02) requires each point source of pollution to install the most efficient pollution control measure available in the program. The most efficient measure that may be applied to a source is defined as that control device or method which results in the lowest pollutant emission rate. All of the control devices applied to the source, as defined by the Control Cost File, are considered. For certain source categories the most efficient pollution control measure may not be technically possible or economically feasible. For example, the most efficient control of fuel combustion sources is often a switch of fuel to natural gas. This may be a practical impossibility on a regional basis. EST02 does, however, represent a potential lower limit of pollutant emissions. A regional strategy based on the application of EST02 to all source category-pollutant combinations provides output summary data which represents the lowest regional emissions based on the application of current technology. This display, together with that generated using EST01 (null-standard), represents upper and lower bounds on the regional air quality and, as such, provides useful planning guidance. It is, therefore, recommended that EST02 be applied to all source categories for both pollutants.

- EST03, EST04 - Restricted Maximum Technology

  Since application of a maximum control measure may be quite unrealistic as a control option, the next two emission standards (EST03, EST04), identical in format, allow user generated modifications to the maximum technology standard (EST02). EST03 and EST04 are designed to allow the user to specify up to ten control devices or methods which are to be excluded from consideration when the most efficient control device is determined. For example, fuel switches to natural gas may be excluded. A separate set of control devices to be excluded can be input for each of these emission standards. Both of these standards may be applied to either pollutant and all emission source categories.

- EST05, EST06, EST07 - Potential Emission Standards

  Emission standards five through seven (EST05, EST06, EST07) simulate emission restrictions that are based on the potential emission rate from each source. The allowable emission rate, in this case, is based on the emission rate that would result if the source was totally uncontrolled. The uncontrolled (i.e., potential) emission rate for each source is computed from the input parameters which characterize the source. The computation uses the existing emission rate, existing control device efficiency and use factor (Chapter 3). The use factor is a ratio of the design operating capacity of the plant or process to the actual operating conditions. This ratio is necessary in the computation of potential emissions since the allowable emission rate, as determined under the emission standard, should reflect the degree of control required to bring the maximum possible source emission into compliance. The following equation is used to determine potential emission rate from any source type for both pollutants.

Potential Emission Rate =

$$\frac{(\text{Existing Emission Rate})(\text{Use Factor})}{1 - \text{Existing Control Efficiency}}$$

The potential emission rate is then converted into the appropriate units (pounds/hour) and the allowable emission rate is determined.

The allowable emission rate determined in this manner may be considered a maximum or design allowable and therefore cannot be directly compared with the existing rate to determine compliance. The control efficiency required under this emission standards type can be determined by the following equation:

Required Control Efficiency =

$$\frac{\begin{pmatrix}\text{Potential}\\ \text{Emission Rate}\end{pmatrix} - \begin{pmatrix}\text{Allowable}\\ \text{Emission Rate}\end{pmatrix}}{\text{Potential Emission Rate}}$$

Since many sources already have existing pollution control equipment, the additional control efficiency required is given by the following equation:

New Control Efficiency =

$$\frac{\begin{pmatrix}\text{Required}\\ \text{Control Efficiency}\end{pmatrix} - \begin{pmatrix}\text{Existing}\\ \text{Efficiency}\end{pmatrix}}{(1 - \text{Existing Efficiency})}$$

This new control efficiency is used to calculate an allowable mass emission rate based on the existing emissions. (All efficiencies displayed in the two equations above are decimal fractions.)

The pre-set curves relating potential to allowable emissions for particulate matter control (under standards EST05, EST06, and EST07) are shown in Figures 6-2, 6-3 and 6-4, respectively. For sulfur dioxide, a single pre-set curve is used for the three standards relating potential to allowable emission rates (Figure 6-1). For particulates, these standards are applicable to industrial processes and solid waste disposal. They may be applied to all source categories for sulfur dioxide control.

- EST08, EST09, EST10 - Heat Input Standards

The next set of emission standards (EST08, EST09, EST10) represent heat input types of standards applicable to fuel combustion for indirect heating. The heat input quantity (in units of 10^6 BTU/hr) is used to define an allowable emission rate. The quantity of heat input on a design or maximum basis (whichever is greater) is a required user input to the Source File. This value must be present in the Source File record of each fuel combustion source before these standards are applied. Since the allowable emission rate is calculated on a design basis it must be corrected to reflect the actual source operating practice before a decision can be made concerning the degree to which existing emissions must be reduced. The correction is achieved by use of the following equation:

$$\text{Allowable Emission Rate} = \left(\begin{matrix}\text{Design Allowable}\\ \text{Emission Rate}\end{matrix}\right) \frac{\text{Actual Heat Input (BTU/hr)}}{\text{Rated Capacity (BTU/hr)}}$$

The actual heat input computation is based on the fuel usage rates and heat contents supplied by the user in each fuel combustion source record.

The pre-set curves depicting the allowable particulate emission values for standards EST08 and EST10 are displayed in Figure 6-6. Particulate pre-sets for EST09 are shown in Figure 6-7. The sulfur dioxide emission levels pre-set for these standards are shown in Figure 6-5.

- EST11 - Heat Input Plus Physical Stack Height Standard

Emission standard eleven (EST11) also defines allowable emission rates for fuel combustion sources based on input heat capacity. Here, however, the physical stack height of the source is used in determining the appropriate allowable emission curve. Seven stack heights may be input for the standard. Associated with each input stack height is an input set of coordinates defining a curve relating the allowable emission rate to the source input heat capacity. The operational procedure for this emission standard is as follows:

(a) The stack height of each source to which the standard applies is examined to determine which heat input curve is applicable.

(b) If the stack height is above or below the specified limits, an error message is printed and operations are terminated on that particular source.

(c) After the proper curve has been selected (Step a) the allowable emission rate calculation proceeds as in standards eight through ten.

This standard is applicable to fuel combustion sources only. The pre-set curves for sulfur dioxide and particulate control are shown in Figures 6-8 and 6-9, respectively.

- EST12 - Effective Stack Height Standard

Emission standard twelve (EST12) determines the allowable emission rates from the source effective stack height. Input to the standard consists of meteorological parameters; ambient temperature and barometric pressure, average wind speed, and the curve coordinates of allowable emission rate versus effective stack height. After computing the effective stack height, the program uses the curve to determine the allowable emission rate. This standard is applicable to all source categories and to either pollutant. Either the normalized plume rise or the following stack parameters must be included in the Source File for each source to which this standard is applied: stack height, stack diameter, stack exit temperature and the exhaust gas exit velocity. Figure 6-10 shows the pre-set curve for EST12 for both particulate and sulfur dioxide air pollutants.

- EST13, EST14 - Exhaust Concentration Standards

Emission standards thirteen and fourteen (EST13, EST14) specify a maximum allowable exhaust gas concentration. These standards are identical. As the concentration is specified in terms of parts per million by weight these standards apply only to sulfur dioxide emissions. All source categories may be controlled by these two standards. The application of these standards to industrial process and solid waste disposal sources requires the exhaust gas volume and temperature. In the case of fuel combustion sources the fuel use rates are used to compute the volume of exhaust gas that would be produced under specified combustion conditions; this volume is then used to compute the allowable emission rate.

- EST15 - Exhaust Concentration Standard

Emission standard fifteen (EST15) is also an exhaust concentration limitation. In this case, the limit is expressed in terms of grains per standard cubic foot. For this reason, EST15 is only applicable to the control of particulate pollution. Two grain loading values are used in this standard. A process weight value defines the range of source sizes to which each grain loading limitation applies. The Source File record for each source being controlled by EST15 must have a process weight entry. The actual computation of the allowable emission rate proceeds in the same manner as for EST13 and EST14. EST15 applies to all pollutant-source categories except fuel combustion.

- EST16 - Exhaust Concentration Standard

  Emission standard sixteen (EST16) specifies a single exhaust gas concentration value in grains per standard cubic foot. The calculation of an allowable emission rate is carried out on the same basis as is done in EST15. This standard is applicable to all source types for particulate pollution only.

- EST17 - Exhaust Concentration Standard

  Emission standard seventeen (EST17) specifies an allowable exhaust gas concentration in terms of pounds of pollutant emitted per thousand pounds of exhaust gas. The computations carried out in this standard uses the same source parameters as the preceding grain loading standard but with different constant values and scale factors. This standard is applicable to all source types for particulate pollution only.

- EST18, EST19, EST20 - Process Weight Standards

  Emission standards eighteen, nineteen, and twenty (EST18, EST19, and EST20) determine the allowable emission rate from the size of the source (based on the weight of materials processed). A curve is used in each of the standards relating process weight (input to the Source File) in pounds per hour to the maximum allowable emission rate, also given in pounds per hour. These standards may be applied to the industrial process and solid waste disposal categories for both sulfur dioxide and particulate air pollutants. Figures 6-11, 6-12, 6-14, 6-15, 6-16 and 6-17 display the pre-set particulate standards for industrial process and solid waste disposal sources. The sulfur dioxide standards are shown in Figure 6-13.

  As in the case of heat input type standards, the allowable emissions obtained directly from the curves which define the process weight standards represent allowable emissions under maximum operating conditions. These cannot be directly compared with existing emission levels. The following equation is used to calculate an actual allowable emission level.

  $$\text{Actual Allowable Emission Rate} = \frac{\text{Design Allowable Emission Rate}}{\text{Use Factor}}$$

  The actual allowable emission rate is then compared with the existing emission rate to determine the required control efficiency.

- EST21, EST22 - Fuel Type Restrictions

  Emission standards twenty-one and twenty-two (EST21 and EST22) specify restrictions as to the types of fuels which may be burned. The user may elect to eliminate coal, coal and residual fuel oil, or all fuels except natural gas. These standards are only applicable to the control of particulate emissions for fuel combustion sources.

- EST23, EST24, EST25 - Fuel Sulfur Content Standards

  The next three emission standards (EST23, EST24, and EST25) apply sulfur content limitations to the three types of fuels which may be burned (coal, residual oil, and distillate oil). The sulfur content limitations which are available to the user in these standards are those which were included in the regional data base in the Control Cost Program (Subsection 5.2.2). EST23, EST24, and EST25 utilize the sulfur limitation specified for devices 30, 31, and 32, respectively, in the Control Cost Program. These standards are applicable to sulfur dioxide emission control for the fuel combustion source category.

- EST26 - Equivalent Fuel Sulfur Content Restriction

  The last emission standard (EST26) also applies a fuel sulfur content limitation. In this standard, however, the alternative of flue gas desulfurization is allowed if the source's emission level can be reduced by an amount equivalent to an actual fuel substitution. The user may utilize the same sulfur content limitations that were available in EST23, EST24 or EST25. Note that sulfur dioxide emissions from fuel combustion sources may be restricted by application of EST26.

6.2.3 Emission Standards Program Output

Output from the Emission Standards Program consists of the following variables for each source-emission standard considered by the program:

- Source identification (Region, Political Jurisdiction and Category).
- Device cost, pollutant removal efficiency and flag indicating if gas cooling was required.
- Emission rates; existing, allowable and controlled.
- Emission standard number.
- Quantity of fuel (coal, distillate oil, residual oil and gas) used after control.
- Theoretical control efficiency required to reduce the potential (existing control removed) emission to the allowable emissions.

This data is both printed and stored on magnetic tape (defined as the Emission Standards File) for use by the Regional Strategies Program. Subsection 7.7.4 gives a detailed description, and examples, of the output generated.

6.3 EMISSION STANDARDS FILE UPDATE PROGARM

Before proceeding with the execution of the Regional Strategies Program, the output from the Emission Standards Program (as contained on the Emission Standards File) should be reviewed by the user to determine whether any modifications to the data are required. Two conditions commonly occur which require the user to update the file (as opposed to correcting input errors and re-executing the Emission Standards Program). They are:

(a) In any given air quality control region, certain emission standards not available in the program may be of particular interest. Such standards usually require information not in the program (e.g., distance from the point of emission to the nearest property line). The application of unique emission standards requires the user to independently determine (for each source effected) the same set of data that would have been generated by the Emission Standards Program (see Sections 7.7.4 and 7.8).

(b) Manually-input data may also be required in the selection of appropriate control devices to meet each emission standard. For any source, the Emission Standards Program can only consider those control devices selected by the Control Cost Program. If none of the control devices meets an emission standard, then it is impossible to evaluate the cost of implementing that standard. In such a case, it would be desirable for the user to supplement the internal analytic capabilities of the model. Experience has shown that it will usually be possible to specify a device which will produce the necessary emission reduction, as well as an estimate of cost for applying this device to the particular source. Addition of this information to the Emission Standards File will increase the validity of the subsequent Regional Strategies Program evaluation process.

Modification of the Emission Standards File is accomplished by the Emission Standards File Update Program. This program may be used to add or delete file records (i.e., complete device-source data sets) or to update data in existing records. Section 7.7 gives the input and operating procedures for this program.

6.4 REGIONAL STRATEGIES PROGRAM

6.4.1 Regional Strategies Program Input

The Regional Strategies Program utilizes data from the Source File, Emission Standards File, Source Contribution File, and punched card input. Section 7.9 gives the input and operating procedures for this program.

6.4.1.1 Source File Data

The Source File (Chapter 3 and Section 7.2) provides the area source emission rate data. These data are scaled (by user input scale factors and/or projection factors) and, together with the controlled point source emission data, are used in the emission rate summary tables and the calculations for the new air quality data.

6.4.1.2 Emission Standards File Data

The Emission Standards File provides the emission standards data base from which the emission control strategies output is constructed. The contents of this file are described in Subsection 6.2.3.

6.4.1.3 Source Contribution File Data

The Source Contribution File (Chapter 4 and Section 7.4) is used by the Regional Strategies Program to calculate new air quality values based on specified emission control strategies. This file contains the following items:

- Number of receptors and sources
- Date of run
- Background pollutant concentrations for each pollutant
- Calibration constants used by the Air Pollutant Concentration Program for each pollutant
- Identification number and location of each receptor
- For each source: identification, political jurisdiction and uncalibrated pollutant contribution to each receptor.

If multiple sub-regional runs were made by the Air Pollutant Concentration Program (and their Source Contribution Files merged), the receptor identification numbers on the merged file will not correspond to the numbers shown in the individual Air Pollutant Concentration Program output tables. Instead, a consecutive numbering system appears in which each set of receptors is placed in the order in which their files are merged (see Section 7.4).

6.4.1.4 Punched Card Data

The detailed list of punched card input variables required in the operation of the Regional Strategies Program is given in Subsection 7.9.3. In general, the user must specify the following data:

(a) Area Source Scale Factors - Area source scale factors are used to simulate the degree of control over area source emissions expected from a particular control strategy. For each area source scale factor, the existing emission rate is multiplied by the scale factor to produce the controlled emission rate. The user should determine these factors for each strategy tested. One scale factor may be input for each political jurisdiction. In addition, individual area sources may be assigned scale factors. If both inputs are used, the individual area source scale factor will be utilized by the program. One set of scale factors is required for each strategy specified.

(b) Projection Factors. Projection factors for point and/or area sources may be input. These factors are used to modify both the allowable and existing emission rate levels to reflect the expected conditions at some future point in time. These factors are applied in conjunction with a specified emission strategy. The user must review regional economic and population trends and growth rates to determine appropriate projection factors.

(c) Calibration Constants and Background Concentration Values. If the calibration constants or background values used in the Air Pollutant Concentration Program are not desired, they may be replaced by new input constants.

(d) Statistical Parameters. Analysis Data Output tables (as described in Subsection 4.4.4) may be requested as Regional Strategy Program outputs. If these tables are desired, appropriate input data must be supplied (e.g., output receptor number, desired averaging times, geometric standard deviations and percentile levels).

(e) Strategies Specification. For a given pollutant, an Emission standard must be specified for each political jurisdiction-source category combination. Each emission standard selected must, of course, have been previously computed in the Emission Standards Program. The collection of standards for all combinations, for a single pollutant, constitutes a strategy. Any number of strategies may be specified.

6.4.2 Regional Strategies Program Operation

In defining the control strategy for a particular pollutant, the user specifies, for each of the political jurisdictions which make up the region, the number of the emission standard to be applied to the point sources in each category (fuel combustion, industrial process, and solid waste). The Regional Strategies Program then searches the Emission Standards File for all fuel combustion sources in the first political jurisdiction and tabulates the results of the selected emission standard. This process is repeated for the industrial process and solid waste categories, producing a complete emission control strategy for the first political jurisdiction. Repeating this process for the remaining political jurisdictions produces a region wide emission control strategy . A regional control strategy consists of specific emission limitations applied to point sources for a selected pollutant emission (i.e., particulates or sulfur oxide). Area source emissions are not controlled by the strategy, but by use of scale factors which the user may input to simulate emission reductions in this source type.

To evaluate the impact of the region wide emission control strategy on regional air quality, the Source Contribution File is required. The procedure is to adjust each receptor concentration value in the Source Contribution File by adjusting the contribution of each source according to its "new" emission rate. The "new" emission rate for each source is determined as follows:

(a) If the existing emission rate is less than the allowable emission, the existing emission rate is used. Otherwise the allowable emission rate under the appropriate emission standard is used.

(b) For area sources, the input scale factor is applied to the existing emission rate and the resulting emission rate is employed by the program.

If the Source Contribution File is not available (e.g., Air Pollutant Concentration Program not executed, or tape read error of existing file), the program will not produce new air quality values. However, all other output from the program will be produced.

For each specified emission control strategy, the user may also obtain output for projected regional pollutant emissions for some future time period. User input projection factors are used to adjust both the existing and allowable emission rates produced by the applied emission control strategy. For area sources the projection factors are applied to existing and scaled emission rates. Projection factors may be input on an individual source (point and area) bases. As with scale factors, a set of projection factors may be input which apply to all area sources within each political jurisdiction. The individual projection will take precedence over the political jurisdiction factor. After applying these factors, the program calculates the projected air quality values in the same manner that new air quality values were determined.

6.4.3 Regional Strategies Program Output

The output from the Regional Strategies Program is designed to give a comprehensive picture of the impact of each candidate emission control strategy. Since each air pollution control agency is primarily concerned with sources within its own jurisdiction, the effects of a strategy on individual sources are described separately for each jurisdiction. In the presentation of estimated air quality concentrations after application of the strategy, no distinction is made between political jurisdictions .

The types of printed output produced by this Program are described below. Examples of the formatted output, including output variable descriptions are presented in Subsection 7.9.4.

- Input Emission Standards - This output displays the set of emission control standards which were input by the user to make up the emission control strategy. These standards are presented by political jurisdiction and emission source type. This information makes each Regional Strategies output listing a complete, self-contained package for convenience of examination.

- Emission Standard Effect on Source Emissions - This output contains a source by source summary of the effects of each emission standard included in the regional control strategy. In the Regional Strategies Program output this format is repeated for each source category in each political jurisdiction. This output allows the type and efficiency of the control device applied to each source to be examined in relation to the emission level allowed under the emission standard. The examination will permit a judgement regarding the stringency of the emission standard in comparison with the available control technology. In addition the detailed information necessary to evaluate the impact of an emission standard on particular sources or source categories may be determined.

- Jurisdiction Summary - The jurisdiction summary presents the summary data which the Regional Strategies Program computes and outputs for each political jurisdiction within the air quality control region. This output summarizes the overall effect of each emission standard contained in the control strategy being examined. Emission reductions are presented for each source category as well as accumulated totals for the political jurisdiction. The degree of reduction in area source emissions (produced by the user input scale factors) is also displayed. The jurisdictional fuel use pattern following the application of these emission standards is shown. Since each political jurisdiction has the authority to set its own emission standards, this data provides the user with valuable planning information.

- Regional Summary - The output of the Regional Strategies Program contains a number of summary statistics which indicate the degree of pollutant reductions expected from the application of each control strategy tested. These data consist of the total pollution reductions, costs required in each political jurisdiction, and the aggregated regional values. An additional parameter is output, which relates the total regional cost of implementing the strategy to the average reduction in ground level pollutant concentration.

- Ground Level Concentrations - The most important decision which must be made concerning each control strategy tested is whether or not the application of the strategy allows achievement of regional air quality goals. This output displays the computer generated estimates of air pollutant concentrations following the point and area source reductions called for under the control strategy. The program also outputs this data in punched card form so that an isopleth plot can be produced for easy visualization of the resulting concentrations. (An example of such an air quality plot is shown in Chapter 1 of Volume II.)

If projection factors are used to produce simulated emission levels representing some future time period, the following three tables will also be output by the Regional Strategies Program.

- Projected Emission Inventory - This output indicates the revised projected emission levels for each emission source within the region. Both the existing emission rate and the "allowable" emission, as defined by the emission standards which make up the control strategy, are displayed in this tabulation.
- Projected Emissions Summary - This is a summary table showing the accumulated projected emission levels for each political jurisdiction and on a region wide basis.
- Projected Ground Level Concentrations - When the user selects the projection option, the Regional Strategies Program produces a tabulation of ground level pollutant concentrations based on the projected emission levels. A punched card output from which isopleth maps may be produced is also generated. This output, both printed and punched cards, uses the same format as the mean pollutant concentration output, without projection.

7.0 USER'S GUIDE

7.1 INTRODUCTION

The Implementation Planning Program is a collection of distinct programs which are, in practice, executed independently. This chapter presents the detailed input methods required for execution of each program. It is assumed that at this point the user has the basic data and all that is required is its conversion to proper form and input to the computer. Descriptions of the collection and significance of the data base for each program are given in Chapters 3 through 6.

7.1.1 Guide Organization

The card input description of each program is contained in a seperate subsection of this chapter. Figure 7.1-1 illustrates the chapter divisions and the overall system flow of the Implementation Planning Program. This illustration is an expanded version of Figure 2-2.

The Roman numerals I-IV in Figure 7.1-1 indicate the sequence in which the program segments are executed under conditions of normal usage. To completely utilize the capabilities of the Implementation Planning Program, all of its component segments must be executed. However, within the segments, the Source Contribution File Merge Program, and the Control Cost and Emission Standards Update programs may or may not be required. The applications of these programs are discussed in Chapters 2 through 6 and Sections 7.4, 7.6 and 7.8.

7.1.2 General Setup Information

To operate each of the programs, the user must prepare punched card data, required for program operation, and Job Control Language (JCL) cards, which relate the program requirements to the computing facility characteristics.

Punched-Card Input Data

There are several types of punched-card input data which must be prepared for operation of the Implementation Planning Program. These are:

(a) Fixed-Format inputs require the user to locate input data exactly as specified in the instructions. The instructions

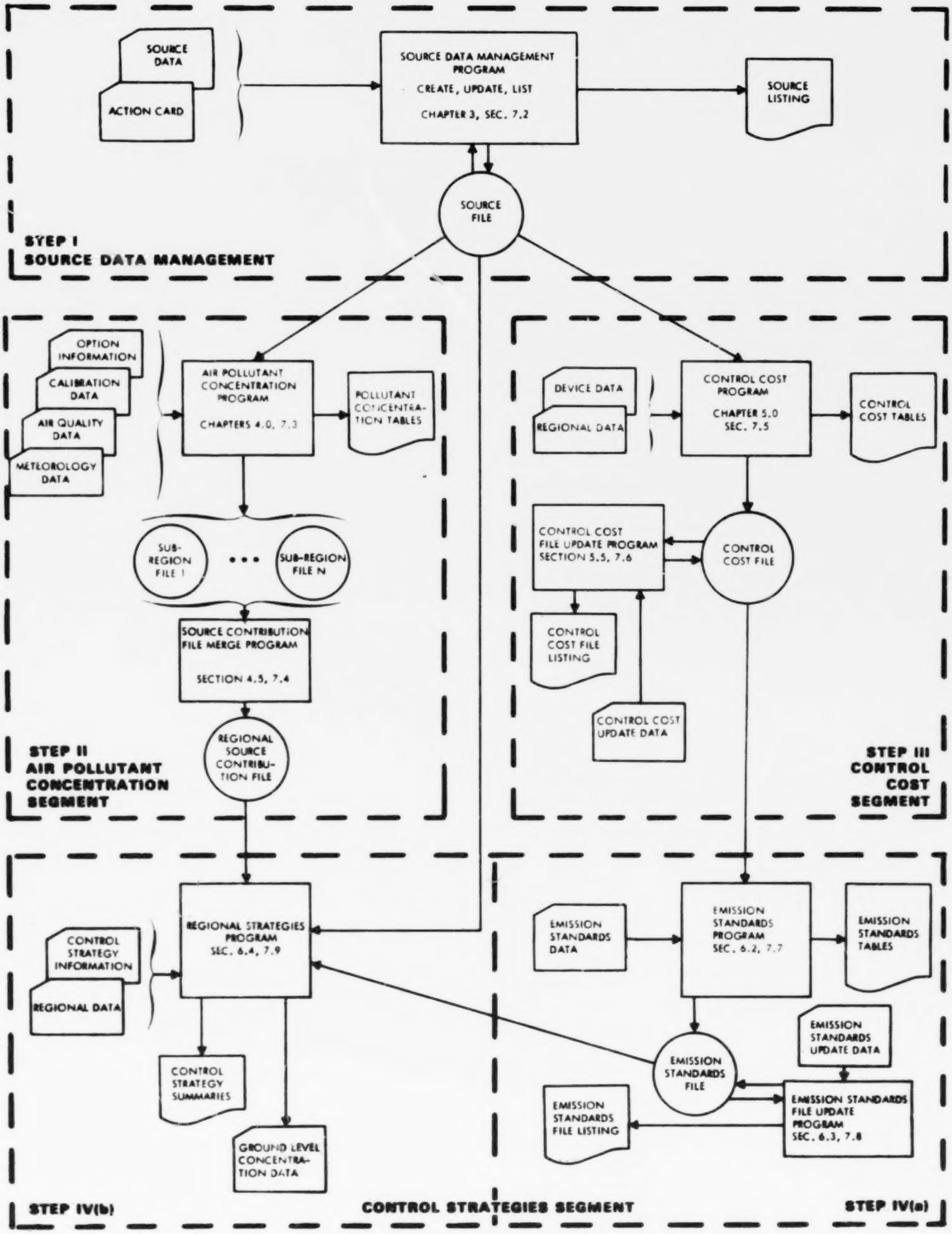

SOURCE DATA
ACTION CARD
SOURCE DATA MANAGEMENT PROGRAM
CREATE, UPDATE, LIST
CHAPTER 3, SEC. 7.2
SOURCE LISTING
SOURCE FILE
STEP I
SOURCE DATA MANAGEMENT
OPTION INFORMATION
CALIBRATION DATA
AIR QUALITY DATA
METEOROLOGY DATA
AIR POLLUTANT CONCENTRATION PROGRAM
CHAPTERS 4.0, 7.3
POLLUTANT CONCENTRATION TABLES
SUB-REGION FILE 1
SUB-REGION FILE N
SOURCE CONTRIBUTION FILE MERGE PROGRAM
SECTION 4.5, 7.4
REGIONAL SOURCE CONTRIBUTION FILE
STEP II
AIR POLLUTANT
CONCENTRATION
SEGMENT
DEVICE DATA
REGIONAL DATA
CONTROL COST PROGRAM
CHAPTER 5.0
SEC. 7.5
CONTROL COST TABLES
CONTROL COST FILE UPDATE PROGRAM
SECTION 5.5, 7.6
CONTROL COST FILE
CONTROL COST FILE LISTING
CONTROL COST UPDATE DATA
STEP III
CONTROL
COST
SEGMENT
CONTROL STRATEGY INFORMATION
REGIONAL DATA
REGIONAL STRATEGIES PROGRAM
SEC. 6.4, 7.9
CONTROL STRATEGY SUMMARIES
GROUND LEVEL CONCENTRATION DATA
EMISSION STANDARDS DATA
EMISSION STANDARDS PROGRAM
SEC. 6.2, 7.7
EMISSION STANDARDS TABLES
EMISSION STANDARDS UPDATE DATA
EMISSION STANDARDS FILE
EMISSION STANDARDS FILE UPDATE PROGRAM
SEC. 6.3, 7.8
EMISSION STANDARDS FILE LISTING
STEP IV(b)
CONTROL STRATEGIES SEGMENT
STEP IV(a)

Figure 7.1-1. Implementation Planning Program Sequence.

include column numbers and the exact form of the input data required.

(b) NAMELIST inputs allow the user a free-form flexibility in locating input data between columns 2 and 80 of the punched card. The user is instructed to provide the name of the variable, followed by an equal sign and then the single or multiple values of the variable. Each value associated with a variable must never exceed the maximum number specified in the instructions. If repetitive values are encountered while preparing the input data, a special format can be used which specifies the number of repetitions and the value of the variable. For example, the format 10*.7 represents ten entries of the values .7. The number of value entries per punched card is left up to the user, but with the stipulation that each value (including the last value entered) must be followed by a comma. Three input modes are used in the NAMELIST format:

Floating Point - A decimal point can appear anywhere in the field used for the value. A field is defined as the number of columns between commas or between the equals sign and the first comma. A comma must separate multiple values and must follow the last value. The values may also be expressed in exponential form, with a number such as 100 input as .100E3.

Integer - No decimal points are used. The comma separating values or ending a string of values must immediately follow the last digit of a value. The values must be right-justified with respect to the commas.

Alphabetic - All alphabetic values must be enclosed in single quotes and must be followed immediately by a comma.

A description of the input data for each program is given which includes the type of data required and the results to be expected if the data is omitted. A specific "Data Type" code is associated with each NAMELIST and fixed-format punched card input. Neither the code nor the description is punched on cards; it is merely a guide to the user. The code is as follows:

O - Data is optional and is not required for program operation.

M - Data is mandatory and is required for program operation.

N - Data is in the NAMELIST format.

P - Floating point mode.

I - Integer mode.

A - Alphanumeric mode.

F - Data is in the fixed format.

Job Control Language Inputs

Job Control Language inputs are used to control the operation of the program and to specify certain computing facility characteristics. The user must coordinate the preparation of these punched cards with the systems programmers assigned to the computing facility. The Job Control Language inputs for the execution of each program are shown in the actual form prepared for the installation test case (Volume II, Chapter 3) at the TRW Systems computing facility (an IBM 360/40 computer operating under OS Release 18). The user should note however, that some of these inputs are unique to the TRW facility (e.g., tables and tape numbers). The user is advised to refer to IBM [1969] and to seek the assistance of systems programmers assigned to his installation for preperation of the JCL inputs. No attempt will be made in this chapter to describe each element of the JCL input cards.

7.2 SOURCE DATA MANAGEMENT PROGRAM

7.2.1 Description

The Source Data Management Program is written in the Common Business Oriented Language (COBOL), a computer program language specifically designed for business rather than scientific problems. COBOL has many features which are directly applicable to maintenance of data files. COBOL is like a natural language in that it has a vocabulary and grammar of its own. Under the guidance of a COBOL computer programmer, changes can be made to the Source Data Management Program by forming sentences and paragraphs describing these changes in the COBOL language. The system can be changed to increase the number of fields per record, the number of records per file, or any other system aspect.

The overall flow of the Source Data Management Program is shown in Figure 7.2-1. This program is used to perform each of the following operations:

(a) File Creation

(b) File Update - This includes deletion of existing source records, data changes for existing records, and addition of new records.

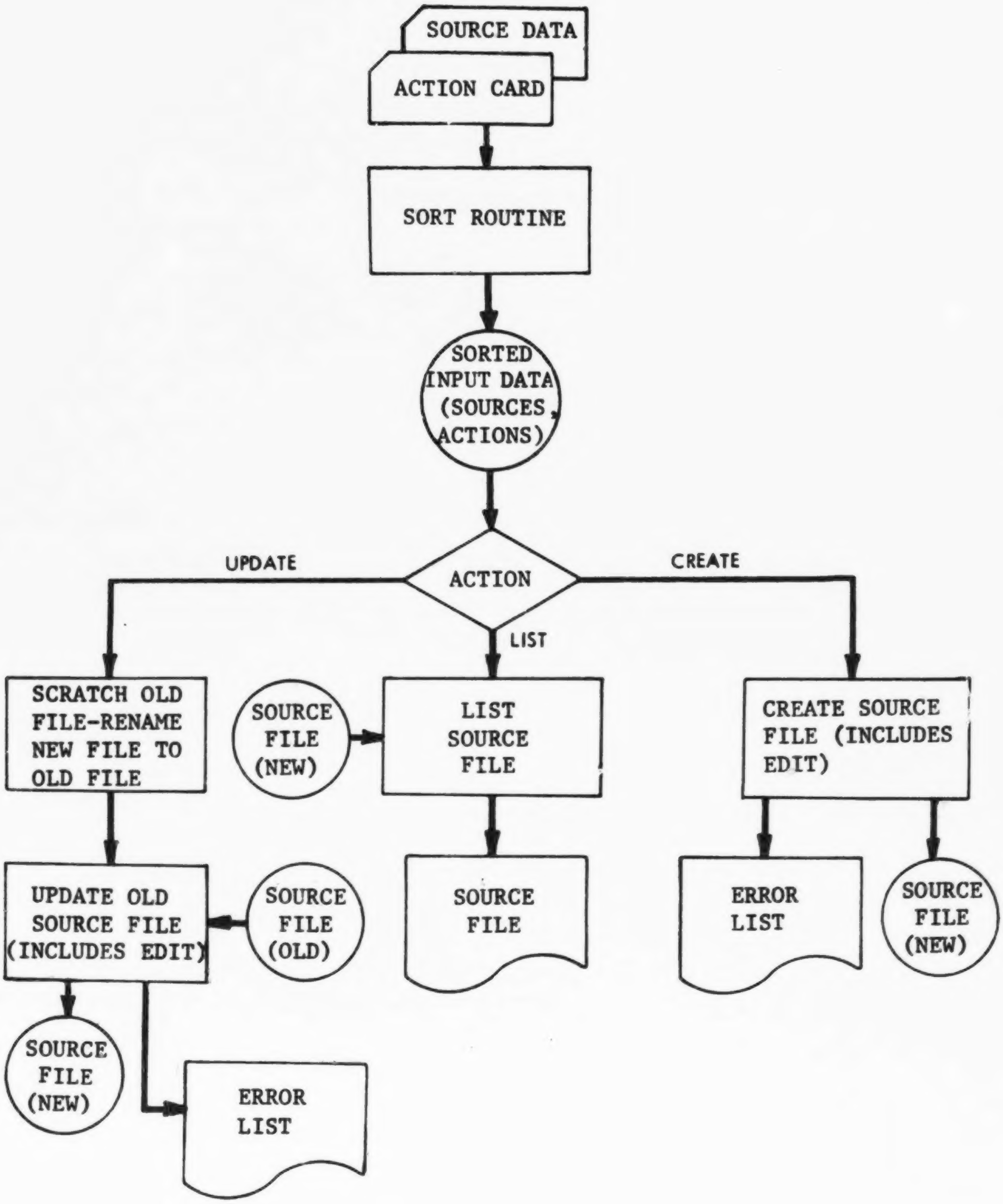
(c) File Listing.

During the creation and update operations the program manipulates the input data as follows:

(a) Edit - Inputs are edited for numeric and alphabetic fields and for valid codes. Warnings are printed for invalid fields and the record is rejected (warning messages are summarized in Chapter 8).

(b) Conversion - Data inputs in feet and feet/sec are converted to the metric system, temperature in degrees Fahrenheit is converted to degrees Kelvin, and exponential inputs are converted to non-exponential equivalents.

Although the program is designed to perform only one of the above operations at a time (i.e., for a given job step), several operations may be combined for a given run (e.g., file update and file listing).



SOURCE DATA
ACTION CARD
SORT ROUTINE
SORTED INPUT DATA (SOURCES, ACTIONS)
ACTION
UPDATE
LIST
CREATE
SCRATCH OLD FILE-RENAME NEW FILE TO OLD FILE
SOURCE FILE (NEW)
LIST SOURCE FILE
CREATE SOURCE FILE (INCLUDES EDIT)
UPDATE OLD SOURCE FILE (INCLUDES EDIT)
SOURCE FILE (OLD)
SOURCE FILE
ERROR LIST
SOURCE FILE (NEW)
SOURCE FILE (NEW)
ERROR LIST

Figure 7.2-1. Source Data Management Program Major Functions.

7.2.2 JCL and Deck Setup

The input deck setup required for the execution of the program consists of the job control language (JCL) cards, the program deck, the program action card, and the data cards set.

Figure 7.2-2 illustrates the deck setup for an update and list run. The JCL cards associated with this setup are shown in Figure 7.2-3. This setup was used for the installation test case with the following assumptions:

(a) Source Data Management Program in object deck form

(b) Source File is on disk

(c) Object deck for list operation is referenced back to update operation (therefore a second object deck is not required for this run).

Deviations from this configuration require appropriate JCL card changes. Figure 7.2-4 illustrates the JCL cards used for the create and list run of the installation test case.

7.2.3 Input

In addition to the JCL cards, the user must provide the action card and the source data cards (both point and area) described in the following subsections. Since these cards are ordered by the program they may be input in any order. It is recommended however, that the input be arranged in the order in which it is used, that is: action card, point source data cards, and area source data cards.

7.2.3.1 Action Cards

This card describes the action that the program is to perform, i.e., create, update, or list. The formats for the action cards are provided in Table 7.2-1. Since only a few action cards are involved in the Implementation Planning Program, no special data form has been designed and the user should employ the standard data forms available at his computing facility.

In using Table 7.2-1. and succeeding tables of this form, the user should note that the notation "AAA" or "3A" under the heading "Picture" means that the user should punch (or write on the data forms) three

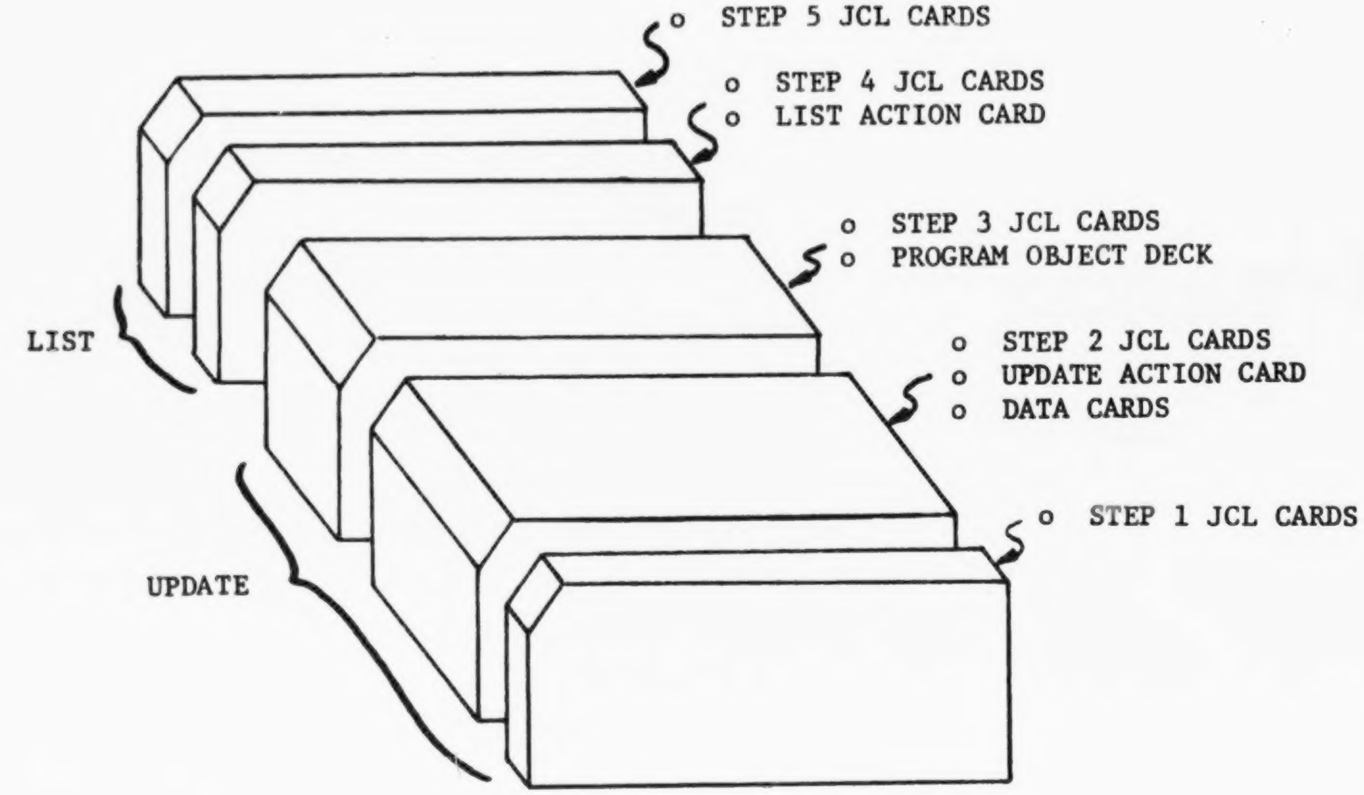

o STEP 5 JCL CARDS
o STEP 4 JCL CARDS
o LIST ACTION CARD
o STEP 3 JCL CARDS
o PROGRAM OBJECT DECK
o STEP 2 JCL CARDS
o UPDATE ACTION CARD
o DATA CARDS
o STEP 1 JCL CARDS
LIST
UPDATE

Figure 7.2-2. Example Deck Configuration for Source File Update and List Run.

```
            SOURCE: UPDATE AND LIST

//STEP1     EXEC PGM=IEHPROGM
//SYSPRINT DD SYSOUT=A
//DD1       DD UNIT=2314,DISP=OLD,VOL=SER=000078
//SYSIN     DD *
      SCRATCH  DSNAME=OLDSORCE,VOL=2314=000078
      RENAME DSNAME=NEWSORCE,VOL=2314=000078,NEWNAME=OLDSORCE
/*
//STEP2     EXEC  SORTD
//SORT.SORTIN  DD *,DCB=(RECFM=FB,LRECL=80,BLKSIZE=80)

                    UPDATE ACTION CARD
                    SOURCE DATA CARDS
/*
//SORT.SORTWK01 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK02 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK03 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK04 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK05 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK06 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTOUT  DD DSN=&SRTDTRAN,UNIT=SYSDA,SPACE=(CYL,(1,1)),
//              DCB=(RECFM=FB,LRECL=80,BLKSIZE=1600),DISP=(NEW,PASS)
//SORT.SYSIN    DD *
 SORT FIELDS=(1,12,A,80,1,A,79,1,D),FORMAT=CH
 END
/*
//STEP3  EXEC  COBFLG
//LKED.SYSIN  DD  *

                      OBJECT DECK

/*
//GO.TRANS  DD DSN=&SRTDTRAN,DISP=(OLD,DELETE)
//GO.OLD   DD DSN=OLDSORCE,UNIT=2314,VOL=SER=000078,DISP=OLD
//GO.NEW    DD DSN=NEWSORCE,UNIT=2314,VOL=SER=000078,
//    DCB=(RECFM=FB,LRECL=221,BLKSIZE=2214),
//              DISP=(NEW,KEEP),
//              SPACE=(CYL,(1,1))
//GO.ERROR DD SYSOUT=A
/*
//STEP4     EXEC  SORTD
//SORT.SORTIN  DD *,DCB=(RECFM=FB,LRECL=80,BLKSIZE=80)

                    LIST ACTION CARD

/*
//SORT.SORTWK01 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK02 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK03 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK04 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK05 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK06 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTOUT  DD DSN=&SRTDTRAN,UNIT=SYSDA,SPACE=(CYL,(1,1)),
//              DCB=(RECFM=FB,LRECL=80,BLKSIZE=1600),DISP=(NEW,PASS)

//SORT.SYSIN    DD *
 SORT FIELDS=(1,12,A,80,1,A,79,1,D),FORMAT=CH
 END
/*
//STEP5  EXEC  PGM=*.STEP3.LKED.SYSLMOD,
//      COND=((5,LT,STEP3.LKED))
//STEP5.TRANS  DD DSN=&SRTDTRAN,DISP=(OLD,DELETE)
//STEP5.OLD    DD  DUMMY
//STEP5.NEW  DD DSN=NEWSORCE,DISP=OLD,VOL=SER=000078,UNIT=2314
//STEP5.ERROR    DD  SYSOUT=A
//STEP5.SYSIN  DD  DUMMY
/*
```

Figure 7.2-3. Example JCL Card Setup for Source File Update and List Run.

```
              SOURCE:  CREATE & LIST
//STEP1       EXEC SORTD
//SORT.SORTIN  DD *,DCB=(RECFM=FB,LRECL=80,BLKSIZE=80)

                 CREATE ACTION CARD

                 SOURCE DATA CARDS

/*
//SORT.SORTWK01 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK02 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK03 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK04 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK05 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK06 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTOUT  DD DSN=&SRTDTRAN,UNIT=SYSDA,SPACE=(CYL,(1,1)),
//              DCB=(RECFM=FB,LRECL=80,BLKSIZE=1600),DISP=(NEW,PASS)
//SORT.SYSIN     DD *
 SORT FIELDS=(1,12,A,80,1,A,79,1,D),FORMAT=CH
 END
/*
//STEP2  EXEC  CORFLG
//LKED.SYSIN  DD  *

                     OBJECT DECK

/*
//GO.TRANS  DD DSN=&SRTDTRAN,DISP=(OLD,DELETE)
//GO.OLD    DD DUMMY
//GO.NEW    DD DSN=NEWSORCE,UNIT=2314,VOL=SER=000078,
//   DCB=(RECFM=FB,LRECL=221,BLKSIZE=2214),
//              DISP=(NEW,KEEP),
//              SPACE=(CYL,(1,1))
//GO.ERROR DD SYSOUT=A
/*
//STEP3    EXEC SORTD
//SORT.SORTIN  DD *,DCB=(RECFM=FB,LRECL=80,BLKSIZE=80)

                  LIST ACTION CARD

/*
//SORT.SORTWK01 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK02 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK03 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK04 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK05 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTWK06 DD UNIT=SYSDA,SPACE=(CYL,(10),,CONTIG)
//SORT.SORTOUT  DD DSN=&SRTDTRAN,UNIT=SYSDA,SPACE=(CYL,(1,1)),
//              DCB=(RECFM=FB,LRECL=80,BLKSIZE=1600),DISP=(NEW,PASS)
//SORT.SYSIN    DD *
 SORT FIELDS=(1,12,A,80,1,A,79,1,D),FORMAT=CH
 END
/*
//STEP4  EXEC  PGM=*.STEP2.LKED.SYSLMOD,
//             COND=((5,LT,STEP2.LKED))
//STEP4.TRANS  DD DSN=&SRTDTRAN,DISP=(OLD,DELETE)
//STEP4.OLD   DD  DUMMY
//STEP4.NEW  DD DSN=NEWSORCE,DISP=OLD,VOL=SER=000078,UNIT=2314
//STEP4.ERROR   DD  SYSOUT=A
//STEP4.SYSIN  DD  DUMMY
```

Figure 7.2-4. Example JCL Card Setup for Source File Create and List Run.

TABLE 7.2-1

ACTION CARD FORMAT

Column	Picture	Description	Edit Action
1-3	XXX	Region Number (001 thru 999)	
4-9	AAAAAA	Action Code; enter CREATE or UPDATE	Create or Update
10-27	18A	Creation or Update Date; this date is printed by other programs to identify Source File used.	
28-80	Blanks		

-- For Create or Update use Above Format; For List Use Format Below --

Column	Picture	Description	Edit Action
1-3	XXX	Region Number	
4-9	AAAAAA	Action Code; Enter LIST (left justified)	List
10-29	20A	Region Name	
30-80	Blanks		

alphanumeric* symbols in the columns indicated under the heading "Column" of the table. The notation "5X" or "XXXXX" means that the user should punch five numeric** symbols in the columns indicated. The notation 'XX.XX" means that the user should punch four numeric symbols in the columns indicated. In this case the program will assume that a decimal point exists between the second and third numeric symbols.

The user should note further that the information given in the Picture column does not imply that any alphanumeric or numeric symbols are acceptable. The further restrictions on actual symbols that may be punched are detailed under "Description" in Table 7.2-1. Furthermore, the notation "Blank" means that nothing is punched in the columns indicated.

7.2.3.2 Point Source Punched Card Input

The basic point source data format consists of three punch cards for each source. The formats for the point source data cards are described in Table 7.2-2. When constructing the deck the input cards can be arranged in any order. The sort function of the program will sequence the point source cards in ascending order on columns 1-12 and 80. Column 80 contains the card number (1, 2 or 3). Columns 1-12 contain the identification field consisting of the region number, SIC code, site number, and process code, in that order. The data cards are also sequenced on column 79 in descending order. Column 79 contains the transaction code, defined as follows:

(a) Add - when creating the source file or adding a point source to the file in an update procedure, the transaction code is A. At least cards 1 and 3 are required in this case.

(b) Change - In an update procedure, when changing a data field for an existing point source in the Source File, the transaction code is C. When a change is made to a field, the entire card containing that field must be reentered. However, only those cards in the set of three cards having changed fields are required.

---

*A,----, 2,0,1,----,9,$, etc.

**0,1,---,9.

TABLE 7.2-2A

POINT SOURCE INPUT FORMAT

(Card Number 1)

Column	Picture*	Description	Program Editing Action
1-3	XXX	Region Number (001 thru 999, see Appendix B)	Must be non-blank
4-7	XXXX	SIC Code (four digits, see Table 5-3)	Must be non-blank
8-10	XXX	Site Number (001 thru 999, arbitrary)	Must be non-blank
11-12	XX	Process Code (00 thru 99, see Table 5-3)	Must be non-blank
13-35	23A	Descriptive Name; source name plus brief description	Must be non-blank
36-39	XXX.X	Location X (km)	Must be numeric
40-44	XXXX.X	Location Y (km)	Must be numeric
45-46	XX	Political Jurisdiction (01 thru 10)	Must be numeric
47	A	Ownership	Must be P, L, S F or U
48	A	Source Type	Must be B, P, or S
49-55	XXXX.XXX	SO_2 Emission Rate (ton/day)	Must be non-blank if Particulate Emission Rate is blank. If non-blank, must be numeric
56-62	XXXX.XXX	Particulate Emission Rate (tons/day)	Must be non-blank if SO_2 Emission Rate is blank. If non-blank must be numeric

TABLE 7.2-2A

POINT SOURCE INPUT FORMAT (Continued)

(Card Number 1)

Column	Picture*	Description	Program Editing Action
63-66	XXXX	Operating Time (hrs/yr)	Must be numeric
67-68	X.X	Shifts per Day	Must be numeric
69-71	XX.X	Existing SO_2 Control Efficiency (%)	If non-blank must be numeric
72-75	XX.XX	Existing Particulate Control Efficiency (%)	If non-blank, must be numeric
76-78	XXX	Existing Control Device ID (see Table 5-1)	If non-blank must be numeric
79	A	Transaction Code; enter D if source record is to be deleted, C if change is to be made to an existing source record, A if a source record is to be added	Must be D, C or A
80	X	Card Number = 1	Must be 1

*NOTE:
1. All decimal points are implied.
2. Always right justify. E.g., in columns 1-3, Region No. 1 may be punched as 001 or two blanks and then 1.
3. If the places after (to the right of) an input value are either zero or unknown, then zeros must be punched in all columns after the last digit, e.g., in columns 72-75, ninety nine percent must be punched as nine-nine-zero-zero.
4. When editing function indicates field must be non-blank, then at least one column must be punched, e.g., in columns 11-12 a process code of 00 must be blank-zero-or-zero-zero.

TABLE 7.2-2B

POINT SOURCE INPUT FORMAT

(Card Number 2)

Column	Picture	Description	Program Editing Action
1-3	XXX	Region Number	Identification field-see Card No. 1
4-7	XXXX	SIC Code	
8-10	XXX	Site Number	
11-12	XX	Process Code	
13-17	XXXXX	Rated Capacity (10^6 BTU/hr)	If non-blank, must be numeric; converts to BTU/hr
18-20	XX.X	Coal Heat Content (10^6 BTU/ton)	If non-blank, must be numeric; converts to BTU/ton
21-24	XXX.X	Residual Oil Heat Content (10^3 BTU/gal)	If non-blank, must be numeric; converts to BTU/gal
25-28	XXX.X	Distillate Oil Heat Content (10^3 BTU/gal)	If non-blank, must be numeric; converts to BTU/gal
29-32	XXXX	Gas Heat Content (BTU/Cu.ft)	If non-blank, must be numeric
33-37	XXXXX	Coal Burned (Tons/day)	If non-blank, must be numeric
38-43	XXXXXX	Residual Oil Burned (gal/day)	If non-blank, must be numeric
44-49	XXXXXX	Distillate Oil (gal/day)	If non-blank, must be numeric
50-54	XXXXX	Gas Burned (10^3 ft^3/day)	If non-blank, must be numeric; converts to ft^3/day

TABLE 7.2-2B

POINT SOURCE INPUT FORMAT (Continued)

(Card Number 2)

Column	Picture	Description	Program Editing Action
55-57	X.XX	Coal Sulfur Content in (%)	If non-blank, must be numeric
58-60	X.XX	Residual Oil Sulfur Content (%)	If non-blank, must be numeric
61-63	X.XX	Distillate Oil Sulfur Content (%)	If non-blank, must be numeric
64-68	X.XXXX	Gas Sulfur Content (%)	If non-blank, must be numeric
69-71	XX.X	Coal Ash Content (%)	If non-blank, must be numeric
72-78	Blank		
79	A	Transaction Code; enter A if a source record is to be added, C if a change is to be made to an existing source record	Must be A or C
80	X	Card Number = 2	Must be 2

TABLE 7.2-2C

POINT SOURCE INPUT FORMAT

(Card Number 3)

Column	Picture	Description	Program Editing Action
1-3	XXX	Region Number	Identification field - see Card No. 1
4-7	XXXX	SIC Code	
8-10	XXX	Site Number	
11-12	XX	Process Code	
13-16	XXXX	Stack Height (ft)	If non-blank, must be numeric; converts to meters
17-20	XXXX	Stack Temperature in (^{o}F)	If non-blank, must be numeric; converts to ^{o}Kelvin
21-24	XXXX	Normalized Plume Rise in (ft^{2}/sec)	If non-blank, must be numeric; converts to m^{2}/sec
25-30	XXXXXX	Maximum Process Rate in (10^{2} lb/hr)	If non-blank, must be numeric; converts to lb/hr
31-35	XXXX	Maximum Exhaust Gas Volume (10^{2} ACFM)	If non-blank, must be numeric; converts to ACFM
36-38	XX.X	Stack Diameter (ft)	If non-blank, must be numeric; converts to meters
39-41	XXX	Stack Velocity (ft/sec)	If non-blank, must be numeric; converts to m/sec
42-44	X.XX	Use Factor	If non-blank, must be numeric
45-78	Blank		

TABLE 7.2-2C

POINT SOURCE INPUT FORMAT (Continued)

(Card Number 3)

Column	Picture	Description	Program Editing Action
79	A	Transaction Code; enter A if a source file is to be added; C if a change is to be made to an existing source record	Must be A or C
8	X	Card Number = 3	Must be 3

(c) Delete - In an update procedure, when deleting a point source from the Source File, only the first card is entered. The identification field (columns 1-12), the card number (1 in column 80) and the transaction code D (in column 79) are the only fields punched.

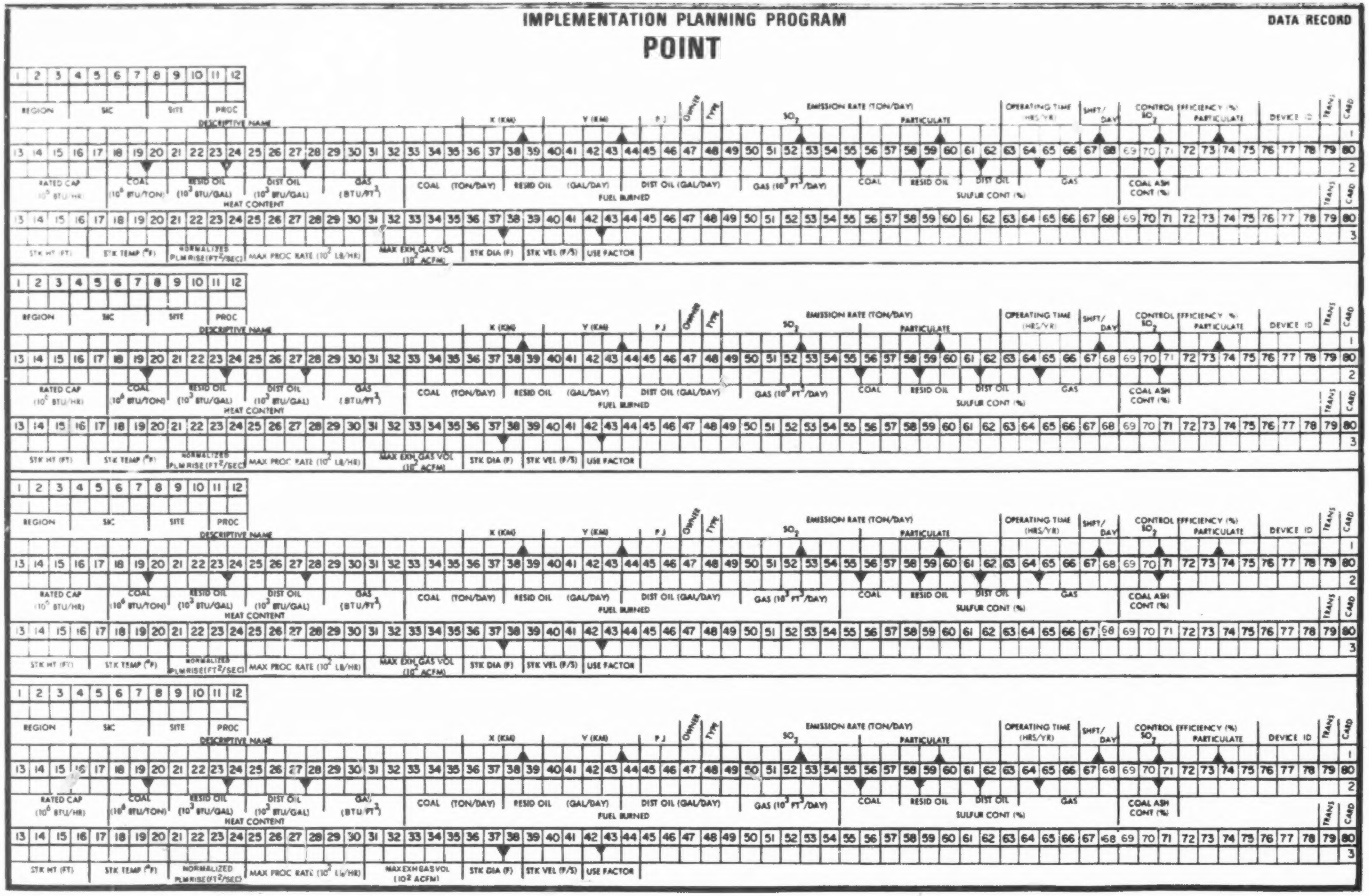
The card sequencing on column 79 takes precedence (i.e., D, C, A). Therefore, when executing an update, all deletion cards are processed first, then changes and last additions. When the file is first created, all the cards must have transaction code A.

Since the point source data will frequently involve a large number of punch cards, special data forms have been designed (Figure 7.2-5) which correspond to Table 7.2-2. Each form has space for four sets of three cards. Since the identification field will be the same for each card in a given set of three, it is segregated on the upper left hand corner of each set. The remaining 68 columns (13-80) of each card are below the identification field. The individual fields are demarcated by short bold vertical lines and the implied decimal point's position is marked by a black triangle.

7.2.3.3 Area Source Punched Card Input

The area source data cards follow the point source data cards in the program job deck and their sequencing follow the same rules given in the previous section. However, only one data card is required for every area source that is to be input to the Source File. The card format is described in Table 7.2-3.

Special data forms have been designed for preparing the area source data. The form is illustrated in Figure 7.2-6. Since the first seven columns will remain unchanged for all area sources within the region, a separate block for these columns is set aside in the upper left hand corner of the data forms. The remainder of the sheet is devoted to the non-blank entries of the card. Each of the twenty-five lines provides the complete data field of a single card. The field demarcations are heavy vertical lines and the implied decimal point locations are indicated by black triangles.



IMPLEMENTATION PLANNING PROGRAM

POINT

DATA RECORD

REGION | SIC | SITE | PROC
DESCRIPTIVE NAME | X (KM) | Y (KM) | P J | OWNER | TYPE | EMISSION RATE (TON/DAY) SO_2 | PARTICULATE | OPERATING TIME (HRS/YR) | SHFT/DAY | CONTROL EFFICIENCY (%) SO_2 | PARTICULATE | DEVICE ID | TRANS | CARD 1
RATED CAP (10^6 BTU/HR) | HEAT CONTENT: COAL (10^6 BTU/TON) | RESID OIL (10^3 BTU/GAL) | DIST OIL (10^3 BTU/GAL) | GAS (BTU/FT^3) | FUEL BURNED: COAL (TON/DAY) | RESID OIL (GAL/DAY) | DIST OIL (GAL/DAY) | GAS (10^3 FT^3/DAY) | SULFUR CONT (%): COAL | RESID OIL | DIST OIL | GAS | COAL ASH CONT (%) | TRANS | CARD 2
STK HT (FT) | STK TEMP (°F) | NORMALIZED PLMRISE (FT^2/SEC) | MAX PROC RATE (10^2 LB/HR) | MAX EXH GAS VOL (10^2 ACFM) | STK DIA (F) | STK VEL (F/S) | USE FACTOR | 3

REGION | SIC | SITE | PROC
DESCRIPTIVE NAME | X (KM) | Y (KM) | P J | OWNER | TYPE | EMISSION RATE (TON/DAY) SO_2 | PARTICULATE | OPERATING TIME (HRS/YR) | SHFT/DAY | CONTROL EFFICIENCY (%) SO_2 | PARTICULATE | DEVICE ID | TRANS | CARD 1
RATED CAP (10^6 BTU/HR) | HEAT CONTENT: COAL (10^6 BTU/TON) | RESID OIL (10^3 BTU/GAL) | DIST OIL (10^3 BTU/GAL) | GAS (BTU/FT^3) | FUEL BURNED: COAL (TON/DAY) | RESID OIL (GAL/DAY) | DIST OIL (GAL/DAY) | GAS (10^3 FT^3/DAY) | SULFUR CONT (%): COAL | RESID OIL | DIST OIL | GAS | COAL ASH CONT (%) | TRANS | CARD 2
STK HT (FT) | STK TEMP (°F) | NORMALIZED PLMRISE (FT^2/SEC) | MAX PROC RATE (10^2 LB/HR) | MAX EXH GAS VOL (10^2 ACFM) | STK DIA (F) | STK VEL (F/S) | USE FACTOR | 3

REGION | SIC | SITE | PROC
DESCRIPTIVE NAME | X (KM) | Y (KM) | P J | OWNER | TYPE | EMISSION RATE (TON/DAY) SO_2 | PARTICULATE | OPERATING TIME (HRS/YR) | SHFT/DAY | CONTROL EFFICIENCY (%) SO_2 | PARTICULATE | DEVICE ID | TRANS | CARD 1
RATED CAP (10^6 BTU/HR) | HEAT CONTENT: COAL (10^6 BTU/TON) | RESID OIL (10^3 BTU/GAL) | DIST OIL (10^3 BTU/GAL) | GAS (BTU/FT^3) | FUEL BURNED: COAL (TON/DAY) | RESID OIL (GAL/DAY) | DIST OIL (GAL/DAY) | GAS (10^3 FT^3/DAY) | SULFUR CONT (%): COAL | RESID OIL | DIST OIL | GAS | COAL ASH CONT (%) | TRANS | CARD 2
STK HT (FT) | STK TEMP (°F) | NORMALIZED PLMRISE (FT^2/SEC) | MAX PROC RATE (10^2 LB/HR) | MAX EXH GAS VOL (10^2 ACFM) | STK DIA (F) | STK VEL (F/S) | USE FACTOR | 3

REGION | SIC | SITE | PROC
DESCRIPTIVE NAME | X (KM) | Y (KM) | P J | OWNER | TYPE | EMISSION RATE (TON/DAY) SO_2 | PARTICULATE | OPERATING TIME (HRS/YR) | SHFT/DAY | CONTROL EFFICIENCY (%) SO_2 | PARTICULATE | DEVICE ID | TRANS | CARD 1
RATED CAP (10^6 BTU/HR) | HEAT CONTENT: COAL (10^6 BTU/TON) | RESID OIL (10^3 BTU/GAL) | DIST OIL (10^3 BTU/GAL) | GAS (BTU/FT^3) | FUEL BURNED: COAL (TON/DAY) | RESID OIL (GAL/DAY) | DIST OIL (GAL/DAY) | GAS (10^3 FT^3/DAY) | SULFUR CONT (%): COAL | RESID OIL | DIST OIL | GAS | COAL ASH CONT (%) | TRANS | CARD 2
STK HT (FT) | STK TEMP (°F) | NORMALIZED PLMRISE (FT^2/SEC) | MAX PROC RATE (10^2 LB/HR) | MAX EXH GAS VOL (10^2 ACFM) | STK DIA (F) | STK VEL (F/S) | USE FACTOR | 3

Figure 7.2-5. Point Source Data Form

TABLE 7.2-3

AREA SOURCE INPUT FORMAT

Column	Picture*	Description	Program Editing Action
1-3	XXX	Region Number (001 thru 999, Appendix B)	Must be non-blank
4-7	XXXX	SIC Code (must be 9999)	Must be non-blank
8-11	XXXX	Site Number (0001 thru 9999 arbitrary)	Must be non-blank
12	X	Process Code (must be 0)	Must be non-blank
13-16	XXX.X	Location X (km)	If non-blank must be numeric
17-21	XXXX.X	Location Y (km)	If non-blank must be numeric
22-25	XXX.X	Area (km^2)	If non-blank must be numeric
26-27	XX	Political Jurisdiction	If non-blank must be numeric
28-31	XXXX	Effective Stack Height (ft.)	If non-blank, must be numeric; convert to meters
32-38	XXXX.XXX	SO_2 Emission Rate (tons/day)	At least one or both
39-45	XXXX.XXX	Particulate Emission Rate (tons/day)	Must be non-blank. If non-blank must be numeric
46-78	Blanks		

---

*All decimal points implied.

TABLE 7.2-3

AREA SOURCE INPUT FORMAT (Continued)

Column	Picture*	Description	Program Editing Action
79	A	Transaction Code; enter D if source record is to be deleted; C if change is to be made to an existing source record, A if a source record is to be added	A, C, or D
80	X	Card Number	Blank

---

*All decimal points implied.

REGION			SIC			
1	2	3	4	5	6	7
			9	9	9	9

IMPLEMENTATION PLANNING PROGRAM

AREA

DATA RECORD

SITE				PROC	LOCATION X (KM)				LOCATION Y (KM)					AREA (KM^2)				POL JUR		STACK HEIGHT (FT.)				EMISSION RATE SO2 (TON/DAY)							EMISSION RATE PART. (TON/DAY)							ACTION
8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	79
				0																																		
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Figure 7.2-6. Area Source Data Form

7.2.4 Output

The major output of the Source Data Management System is the Source file stored on either a permanent disk file or magnetic tape (the Source File record formats are described in Volume II, Chapter 3).

In addition to operations on the Source File itself, the maintenance program provides the printed output:

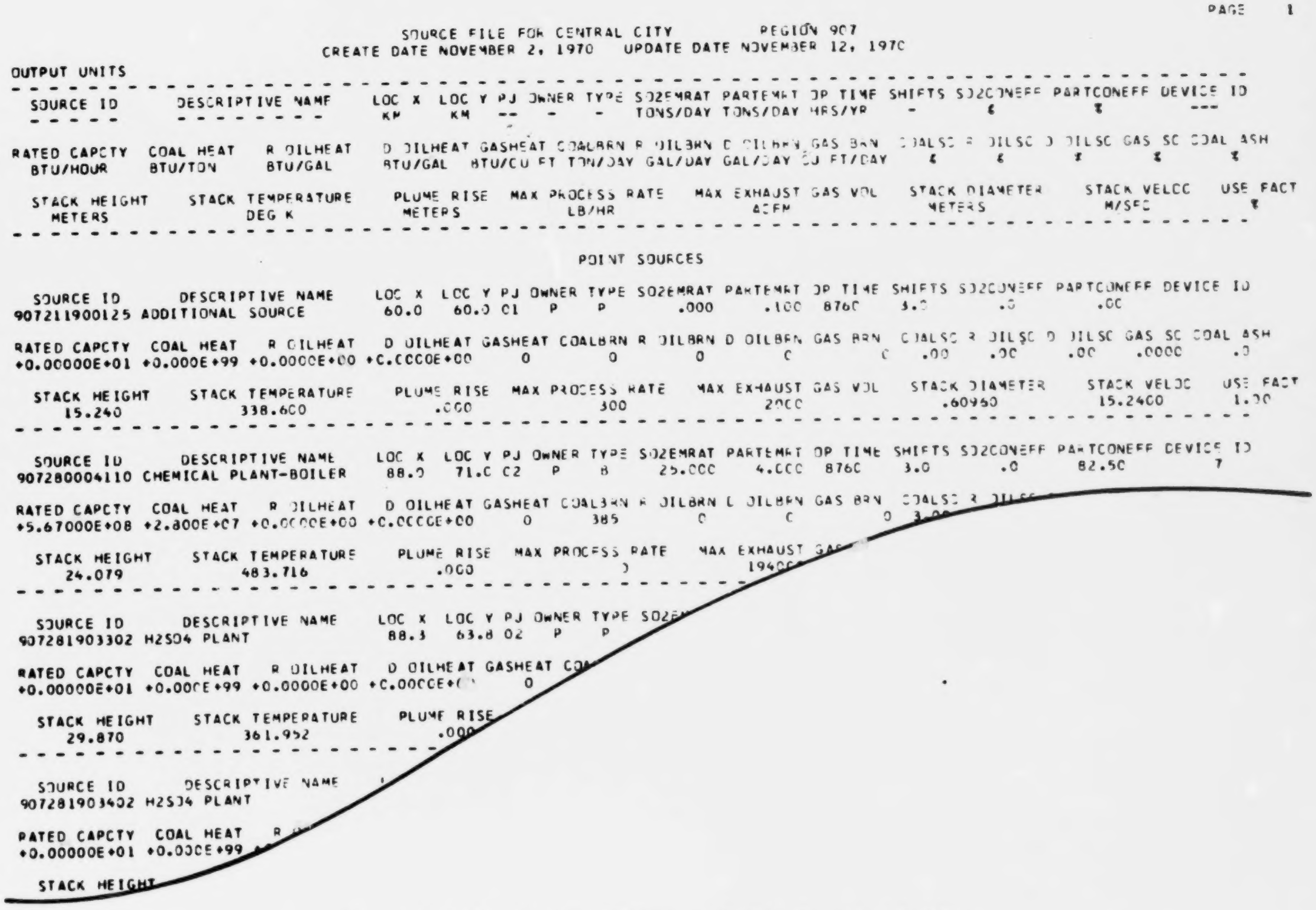
(a) Source File Edit Error Listing

(b) Source File Listing

A description of all error messages is presented in Chapter 8. Each entry in the error list is identified by region, SIC code, and site number designations. In addition, the entries include the field number and parameter value which are in question.

The error list identifies any source which is in error and describes the error. If a card cannot be identified, i.e., a bad identification transaction code or card number, the card is rejected and a message describing the problem is written.

Figures 7.2-7 and 7.2-8 illustrate the output formats for the printed listing of records (sources) in the Source File.



```
                                                                                                              PAGE    1
                                  SOURCE FILE FOR CENTRAL CITY         REGION 907
                              CREATE DATE NOVEMBER 2, 1970   UPDATE DATE NOVEMBER 12, 1970
OUTPUT UNITS
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
  SOURCE ID       DESCRIPTIVE NAME     LOC X  LOC Y PJ OWNER TYPE SO2EMRAT PARTEMRT OP TIME SHIFTS SO2CONEFF PARTCONEFF DEVICE ID
  - - - - -       - - - - - - - -       KM     KM   --    -    -   TONS/DAY TONS/DAY HRS/YR    -       %          %         ---

RATED CAPCTY  COAL HEAT    R OILHEAT    D OILHEAT GASHEAT COALBRN R OILBRN D OILBRN GAS BRN  COALSC R OILSC D OILSC GAS SC COAL ASH
  BTU/HOUR    BTU/TON      BTU/GAL      BTU/GAL  BTU/CU FT TON/DAY GAL/DAY GAL/DAY CU FT/DAY   %       %       %       %       %

  STACK HEIGHT     STACK TEMPERATURE     PLUME RISE  MAX PROCESS RATE    MAX EXHAUST GAS VOL    STACK DIAMETER     STACK VELOC    USE FACT
    METERS               DEG K            METERS          LB/HR                ACFM                 METERS            M/SEC           %
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

                                                          POINT SOURCES

  SOURCE ID       DESCRIPTIVE NAME     LOC X  LOC Y PJ OWNER TYPE SO2EMRAT PARTEMRT OP TIME SHIFTS SO2CONEFF PARTCONEFF DEVICE ID
907211900125 ADDITIONAL SOURCE          60.0   60.0 01   P    P       .000     .100  8760    3.0       .0         .00

RATED CAPCTY  COAL HEAT    R OILHEAT    D OILHEAT GASHEAT COALBRN R OILBRN D OILBRN GAS BRN  COALSC R OILSC D OILSC GAS SC COAL ASH
+0.00000E+01 +0.000E+99 +0.0000E+00 +0.0000E+00     0       0       0       0           0    .00     .00     .00   .0000      .0

  STACK HEIGHT     STACK TEMPERATURE     PLUME RISE  MAX PROCESS RATE    MAX EXHAUST GAS VOL    STACK DIAMETER     STACK VELOC    USE FACT
    15.240              338.600             .000           300                 2000                 .60960          15.2400         1.00
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

  SOURCE ID       DESCRIPTIVE NAME     LOC X  LOC Y PJ OWNER TYPE SO2EMRAT PARTEMRT OP TIME SHIFTS SO2CONEFF PARTCONEFF DEVICE ID
907280004110 CHEMICAL PLANT-BOILER      88.0   71.0 02   P    B     25.000    4.000  8760    3.0       .0       82.50            7

RATED CAPCTY  COAL HEAT    R OILHEAT    D OILHEAT GASHEAT COALBRN R OILBRN D OILBRN GAS BRN  COALSC R OILS
+5.67000E+08 +2.800E+07 +0.0000E+00 +0.0000E+00     0     385       0       0           0 3.00

  STACK HEIGHT     STACK TEMPERATURE     PLUME RISE  MAX PROCESS RATE    MAX EXHAUST GAS
    24.079              483.716             .000             0                 1940
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

  SOURCE ID       DESCRIPTIVE NAME     LOC X  LOC Y PJ OWNER TYPE SO2E
907281903302 H2SO4 PLANT                88.3   63.8 02   P    P

RATED CAPCTY  COAL HEAT    R OILHEAT    D OILHEAT GASHEAT CO
+0.00000E+01 +0.000E+99 +0.0000E+00 +0.0000E+     0

  STACK HEIGHT     STACK TEMPERATURE     PLUME RISE
    29.870              361.952             .000
- - - - - - - - - - - - - - - - - - - - -

  SOURCE ID       DESCRIPTIVE NAME
907281903402 H2SO4 PLANT

RATED CAPCTY  COAL HEAT    R
+0.00000E+01 +0.000E+99

  STACK HEIGHT
```

Figure 7.2-7. Output Format - Point Source Listing.

```
                                                                                                                    PAGE    7
NOTE. DATA GIVEN IN CONVERTED UNITS.                     AREA SOURCES

 SOURCE ID  LOC X(K)  LOC Y(K)   AREA(SQ KM)   PJ   EFFECTIVE STACK HGT(M)   SO2 EMISSION RATE(T/D)   PART EMISSION RATE(T/D)

907999900100   42.0      10.0       400.0       1            .000                    .080                      .010
907999900200   42.0      30.0       400.0       1            .000                    .100                      .023
907999900300   42.0      50.0       400.0       1          10.058                    .500                      .100
907999900400   42.0      70.0       400.0       1          10.058                    .550                      .120
907999900500   62.0      10.0       400.0       1            .000                    .060                      .015
907999900600   62.0      10.0       400.0       2            .000                    .060                      .015
907999900700   62.0      30.0       400.0       1          10.058                    .700                      .190
907999900800   62.0      30.0       100.0       2          10.058                    .100                      .020
907999900900   62.0      50.0       100.0       1          10.058                   6.400                     1.700
907999901000   72.0      50.0       100.0       1          10.058                   8.200                     2.300
907999901100   62.0      60.0       100.0       1          10.058                   7.100                     1.800
907999901200   72.0      60.0       100.0       1          20.116                  19.600                     5.000
907999901300   62.0      70.0       100.0       1          10.058                   3.500                     1.000
907999901400   72.0      70.0       400.0       1          10.058                   4.200                     1.100
907999901500   62.0      80.0       400.0       1          10.058                    .500                      .110
907999901600   82.0      10.0       400.0       2          10.058                    .070                      .010
907999901700   82.0      30.0       100.0       2          10.058                    .300                      .015
907999901800   82.0      50.0       100.0       1          10.058
907999901900   82.0      50.0       100.0       2          20.058
907999902000   82.0      60.0       100.0       1          10.0
907999902100   82.0      60.0       100.0       2
907999902200   82.0      70.0       100.0       1
907999902300   82.0      70.0       100.0
907999902400   92.0      70.0       10
907999902500   82.0      80.0
907999902600   82.0      8
907999902700  102.0
```

Figure 7.2-8. Output Format - Area Source Listing.

7.3 AIR POLLUTANT CONCENTRATION PROGRAM

7.3.1 Description

The Air Pollutant Concentration Program utilizes two types of input; source file data and punched card input.

(a) Source File Data - These data are read by the program and require the user to specify (on the JCL cards) the correct data file to be read by the program. The specific data read from the source file consists of the following items:

- SIC code
- Site code
- Process code
- Source coordinates: x and y (km). For area sources, the area (km^2) is also provided.
- Stack Parameters; stack height (meters), stack exit diameter (meters), stack exit velocity (meters/second) and stack exit temperature (degrees Kelvin). If the diameter, velocity or temperature values are zero, and the normalized plume rise value is zero the program assumes that the stack height value given represents an effective stack height value (see Chapter 4). For area sources the effective stack height (in this case "effective height of release") concept is always used. If the normalized plume rise value is greater than zero, it will be used to determine the plume rise value.
- Emission rate for each pollutant; SO_2 and particulates (tons/day).

(b) Punched Card Input - This input consists of the JCL cards and the card deck data set containing the NAMELIST input parameters. Figure 7.3-1 illustrates the program use and output options, as determined by the input NAMELIST variables. Examples of the types of output are shown in the referenced figures.

7.3.2 JCL and Deck Setup

An example deck setup configuration is illustrated in Figure 7.3-2. Figure 7.3-3 contains the specific JCL cards, corresponding to Figure 7.3-2. The setup illustrated is based on the following configuration:

(a) Program is in object deck form.

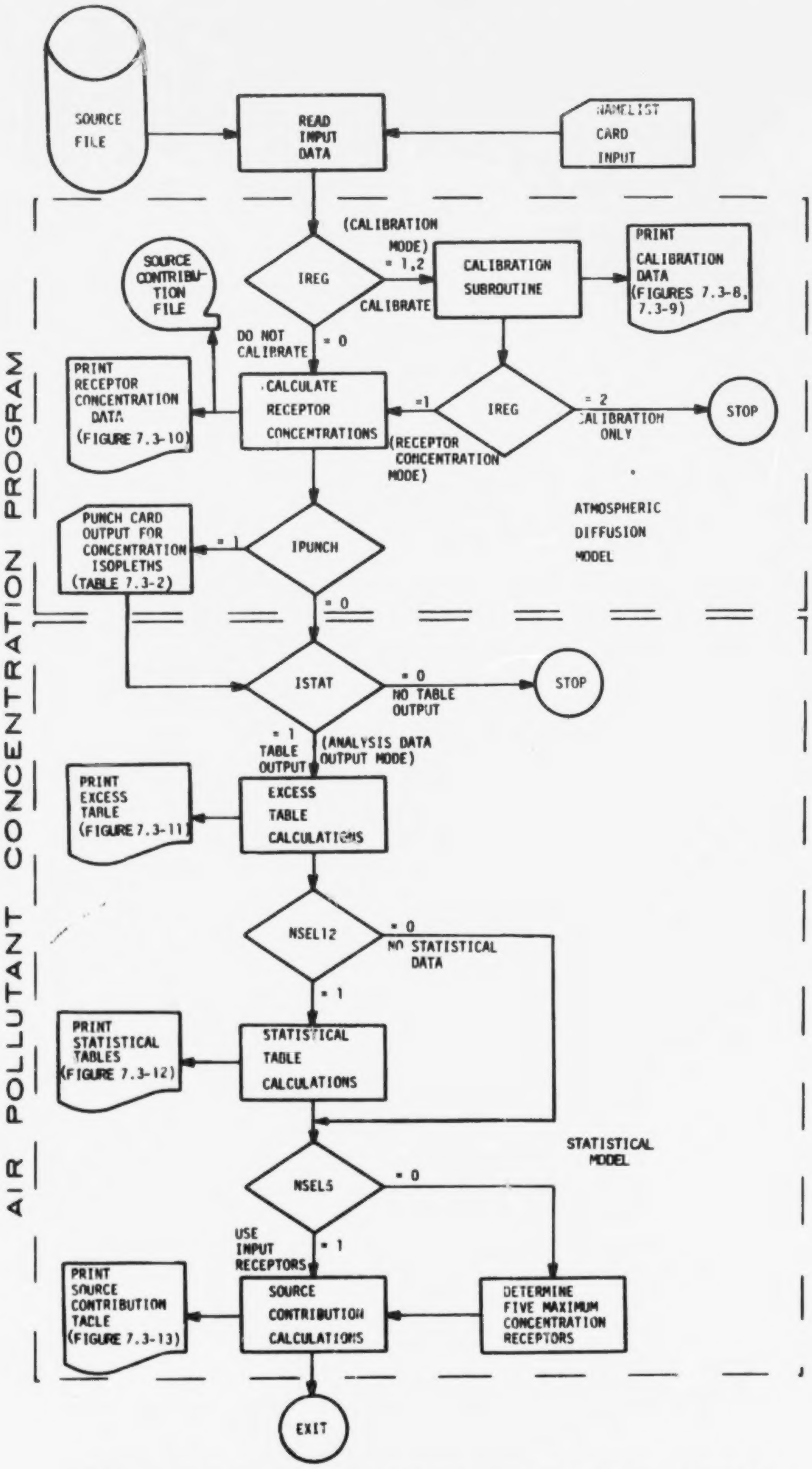

AIR POLLUTANT CONCENTRATION PROGRAM
SOURCE FILE
READ INPUT DATA
NAMELIST CARD INPUT
(CALIBRATION MODE) = 1,2
IREG
CALIBRATE
CALIBRATION SUBROUTINE
PRINT CALIBRATION DATA (FIGURES 7.3-8, 7.3-9)
SOURCE CONTRIBUTION FILE
DO NOT CALIBRATE
= 0
PRINT RECEPTOR CONCENTRATION DATA (FIGURE 7.3-10)
CALCULATE RECEPTOR CONCENTRATIONS
=1
IREG
= 2 CALIBRATION ONLY
STOP
(RECEPTOR CONCENTRATION MODE)
PUNCH CARD OUTPUT FOR CONCENTRATION ISOPLETHS (TABLE 7.3-2)
= 1
IPUNCH
ATMOSPHERIC DIFFUSION MODEL
= 0
ISTAT
= 0 NO TABLE OUTPUT
STOP
= 1 TABLE OUTPUT
(ANALYSIS DATA OUTPUT MODE)
PRINT EXCESS TABLE (FIGURE 7.3-11)
EXCESS TABLE CALCULATIONS
NSEL12
= 0 NO STATISTICAL DATA
= 1
PRINT STATISTICAL TABLES (FIGURE 7.3-12)
STATISTICAL TABLE CALCULATIONS
STATISTICAL MODEL
NSEL5
= 0
USE INPUT RECEPTORS
= 1
PRINT SOURCE CONTRIBUTION TABLE (FIGURE 7.3-13)
SOURCE CONTRIBUTION CALCULATIONS
DETERMINE FIVE MAXIMUM CONCENTRATION RECEPTORS
EXIT

Figure 7.3-1. Air Pollutant Concentration Program Flow.

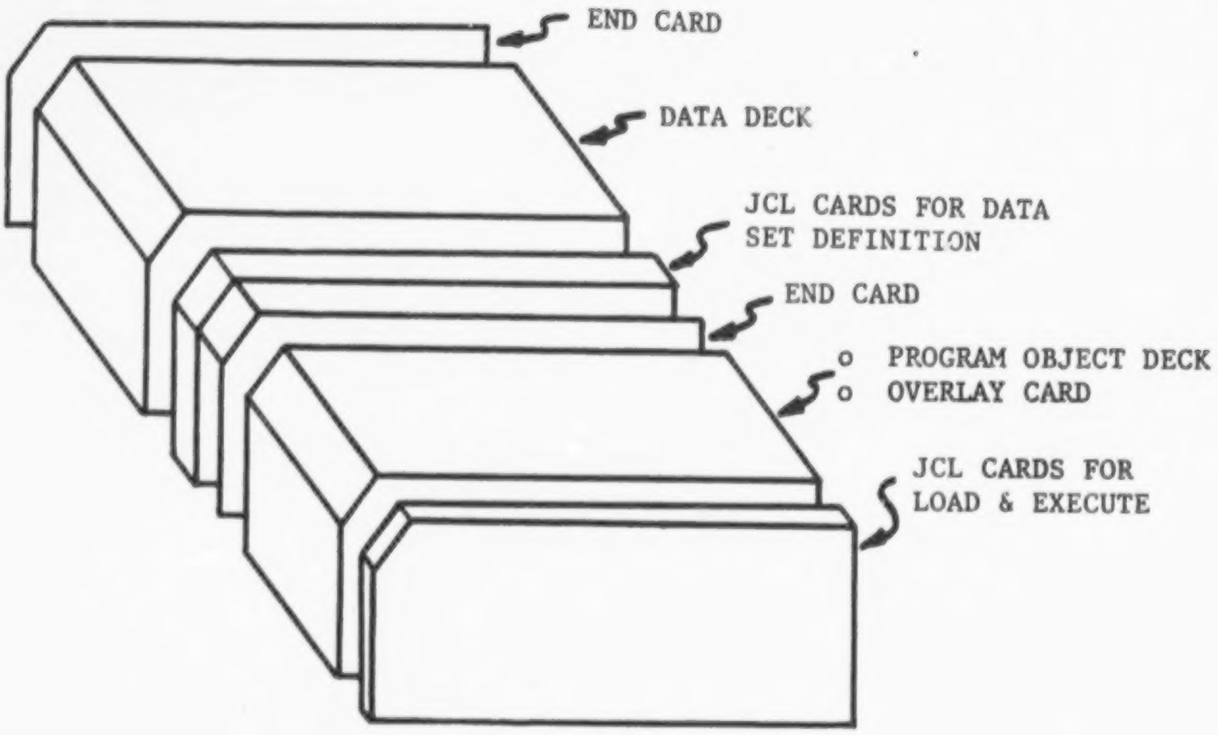

END CARD
DATA DECK
JCL CARDS FOR DATA SET DEFINITION
END CARD
o PROGRAM OBJECT DECK
o OVERLAY CARD
JCL CARDS FOR LOAD & EXECUTE

Figure 7.3-2. Example Deck Configuration for the Air Pollutant Concentration Program.

```
                                JCL FOR AIR POLLUTANT CONCENTRATION PROGRAM

LOAD AND       //LG      EXEC  PROC=FORTGLG,PARM.LKED='MAP,LIST,OVLY,LET'
EXECUTE        //LKED.SYSIN    DD   *

                                OBJECT DECK GOES HERE

                OVERLAY A
                INSERT INPUT,IHCNAMEL
                OVERLAY A
                INSERT CONVRT
                OVERLAY A
                INSERT DIFMOD
                OVERLAY A
                INSERT CAMP
                OVERLAY C
PROGRAM         INSERT POLUT1
OBJECT DECK     OVERLAY C
AND OVERLAY     INSERT REG
CARDS           OVERLAY A
                INSERT POLUT,PLOT
                OVERLAY A
                INSERT SELECT
                OVERLAY A
                INSERT EXCEED,ORDER
                OVERLAY B
                INSERT SEL12
                OVERLAY B
                INSERT POLUT2
END CARD       /*
               //GO.FT11F001  DD UNIT=2314,DSN=NEWSORCE,VOL=SER=000078,DISP=OLD
DATA SET       //GO.FT12F001  DD UNIT=2400,DSN=SCF907,DISP=(NEW,KEEP),
DEFINITION     //                LABEL=(,SL,,OUT),DCB=(RECFM=VBS,LRECL=52,BLKSIZE=1044)
               //GO.SYSABEND DD SYSOUT=A
               //GO.SYSIN       DD *

DATA SET                         DATA DECK GOES HERE

END CARD       /*
```

Figure 7.3-3. Example JCL Card Setup for the Air Pollutant Concentration Program.

NOT REPRODUCIBLE

(b) Program overlay structure is used (see Volume II, Section 3.2).

(c) Source File is on disk.

Deviations from this configuration require appropriate JCL card changes.

7.3.3 Input

The punched card input variables used to construct the Data Set are given in Table 7.3-1. An example data form with prepared inputs is given in Figure 7.3-4.

7.3.4 Output

Three types of output are produced by the program, they are:

(a) Printed output of all calculated concentration data.

(b) Punched card deck of mean concentration values.

(c) Output tape containing source contribution data (Source Contribution File).

The description of the printed and punched card output types are given in the following paragraphs. The format and contents of the Source Contribution File is given in Section 7.4.

Source Data (Figure 7.3-5)

That portion of the Source File data utilized by the program is itemized in a source data output table. The data listed, for each point and area source in the region, includes the source identification, location, area, emission rate, physical stack height, and stack exit parameters: diameter, velocity and temperature. If a normalized plume rise value is used, its value is printed in the stack diameter column and indicated by an asterisk. For area sources, the "Stack Height" column represents the input effective stack height; the data in the stack exit parameter columns however, does not apply.

Meteorological Input Data (Figure 7.3-6)

The input wind roses (frequency of occurrence values for wind direction and speed categories) for the five stability classes are output; one wind rose per page. Figure 7.3-6 illustrates a wind rose for stability class 3. Stability classes 1 through 5 correspond to very unstable,

TABLE 7.3-1

PUNCHED CARD INPUT FOR THE AIR POLLUTANT CONCENTRATION PROGRAM

Data Type	Description
MN	&INDATA - A NAMELIST variable indicating the start of a list of namelist inputs. No equals sign or values are associated with this variable.
ONA	REGIØN - Up to 24 characters (preceded by an apostrophe and followed by an apostrophe and comma) may be used to describe the region being run. If omitted, the Region designation will be blank.
ONA	DATE - Up to 20 characters (preceded by an apostrophe and followed by an apostrophe and comma) may be used to define the run date. If omitted, the date will be blank.
ONI	IPØLU1 - Flag to indicate single pollutant run: one (1) indicates consideration of SO_2 only and a two (2) indicates consideration of particulates only. If omitted or input as zero (0), both pollutants are considered.
MNP	DPTHMX - Mixing height (meters).
MNP	WNDFRQ - Relative frequency of occurrence for each wind speed class, wind direction, and wind stability class combination (480 values). The order of input for the frequency values associated with each stability-wind direction-wind speed combination is as follows: stability 1-direction 1-speed 1, stability 1-direction 1-speed 2,-----, stability 1-direction 1-speed 6, stability 1-direction 2-speed 1, -----, stability 1-direction 2-speed 6,-----, stability 1-direction 16-speed 6,-----, stability 2-direction 1-speed 1,-----, stability 5-direction 16-speed 6.
MNP	TA - Average ambient temperature (degrees Kelvin).
MNP	PA - Average ambient pressure (millibars).
MNP	BLIFE - Half-life factors (hours). The data must be provided in the order: SO_2, Particulate matter.
ONP	BACKGR - Background concentrations (arithmetic mean, micrograms per cubic meter) for each pollutant in the order: SO_2, particulate matter. If omitted background values are assumed to be zero.
ONI	INCRX - Number of columns in the receptor grid. If omitted, this variable is assumed to be zero.

TABLE 7.3-1

PUNCHED CARD INPUT FOR THE AIR POLLUTANT CONCENTRATION PROGRAM (Continued)

Data Type	Description
ONI	INCRY - Number of rows in the receptor grid. If omitted, this variable is assumed to be zero.
ONP	DELTA - Distance (kilometers) between two adjacent rows or columns. If omitted, this variable is assumed to be zero.
ONP	RBASE - X and Y coordinates (kilometers) of southwest corner of receptor grid system. If omitted, these variables are assumed to be zero, zero.
ONI	IADD - Total number of non-grid receptors. This value must be less than or equal to 50. If omitted, this variable is assumed to be zero. If input, XRECEP values must be input.
	NOTE: If both the grid system and IADD are omitted, the run will terminate and print the message: 'RECEPTORS NOT INPUT.'
ONP	XRECEP - X, Y (kilometers) coordinates for the IADD non-grid receptors. If IADD is non-zero, these values must be input.
ONI	IPUNCH - Flag to indicate whether receptor ground level concentration output is to be punched on cards (for use in plotting concentration isopleths). Set to one (1) for punched card output; a zero (0) indicates no punched card output. If omitted, flag will be set to one (1).
MNI	IREG - Flag to indicate which regression option is to be used. A zero (0) indicates that input regression constants are required; one (1) indicates calibration of the model followed by the model run; a two (2) indicates calibration only. If calibration values are to be calculated (IREG = 1 or 2), the following variables must be input: number of stations (NS02 and/or NPART), and station location and measured concentration data (S020B and/or PAR0B). If the calibration constants are input, they are defined by S02CAL and/or PARCAL.
ONP	S02CAL - Regression line constants (y-intercept, slope) for sulfur dioxide. If omitted (and IREG = 0), this variable is set to zero, one.
ONP	PARCAL - Regression line constants (y-intercept, slope) for suspended particulate matter. If omitted (and IREG = 0), this variable is set to zero, one.

TABLE 7.3-1

PUNCHED CARD INPUT FOR THE AIR POLLUTANT CONCENTRATION PROGRAM (Continued)

Data Type	Description
ONI	NS02 - Number of SO_2 measuring stations. If omitted, this variable is assumed to be zero.
ONI	NPART - Number of particulate measuring stations. If omitted, this variable is assumed to be zero.
ONP	S020B - Up to one hundred (100) sets of SO_2 measuring station locations and measured concentration values are input in the following order for each station: x-coordinate and y-coordinate of station and measured concentration value. If omitted, this variable is assumed to contain zero for all values.
ONP	PAR0B - Up to one hundred (100) sets of particulate matter measuring stations and measured concentration values are input in the following order for each station: x-coordinate and y-coordinate of station and measured concentration value. If omitted, this variable is assumed to contain zero for all values.
ONI	ISTAT - Flag to indicate if table data is desired: zero (0) for no output, one (1) for output. These data include the Excess Concentration Table, Source Contribution Table and the Statistical Tables. If omitted, this variable is set to zero.
ONP	AQSTAN - Air quality standard for each pollutant (arithmetic mean in micrograms per cubic meter) input in the order: SO_2, and particulate matter. If omitted, this variable assumed to be zero, zero.
ONI	NSEL5 - Flag to indicate if the five (5) receptors on the Source Contribution table are input (NSEL5 = 1) or are the five receptors of maximum concentration and therefore selected by the program (NSEL5 = 0). If omitted, NSEL5 = 0.
ONI	IC0NS* - Five (5) SO_2 receptor location numbers for source contribution table output. If NSEL5 = 1, all 5 values must be input.

---

*See Footnote on following page.

TABLE 7.3-1

PUNCHED CARD INPUT FOR THE AIR POLLUTANT
CONCENTRATION PROGRAM (Continued)

Data Type	Description
ONI	ICØNP* - Five (5) particulate matter receptor location numbers for source contribution table output. If NSEL5 = 1, all 5 values must be input.
ONI	NSEL12 - Flag to indicate whether statistical output is desired: zero (0) for no, one (1) for yes. If statistical output is requested, the following variables must also be present: Up to twelve (12) receptor numbers per pollutant for statistical output (ISTATS and/or ISTATP); standard geometric deviations corresponding to each receptor number specified (SGDS and/or SGDP); five (5) averaging times for each pollutant (SØ2AVG and/or PARAVG); and three (3) percentile values (PERCNT). If omitted, NSEL12=0.
ONI	ISTATS* - Twelve (12) SO_2 receptor location numbers for statistical output.
ONI	ISTATP* - Twelve (12) particulate matter receptor location numbers for statistical output.
ONP	SØ2AVG - Five averaging times for SO_2 expressed in hours.
ONP	PARAVG - Five averaging times for particulate matter expressed in hours.
ONP	SGDS - Standard geometric deviation (24-hour period) for SO_2 corresponding to the ISTATS receptor numbers. These values must be input in the same order as the receptor location numbers to which they refer.
ONP	SGDP - Standard geometric deviations (24-hour period) for particulate matter corresponding to the ISTATP receptor numbers. The values must be input in the same order as the receptor location numbers to which they refer.

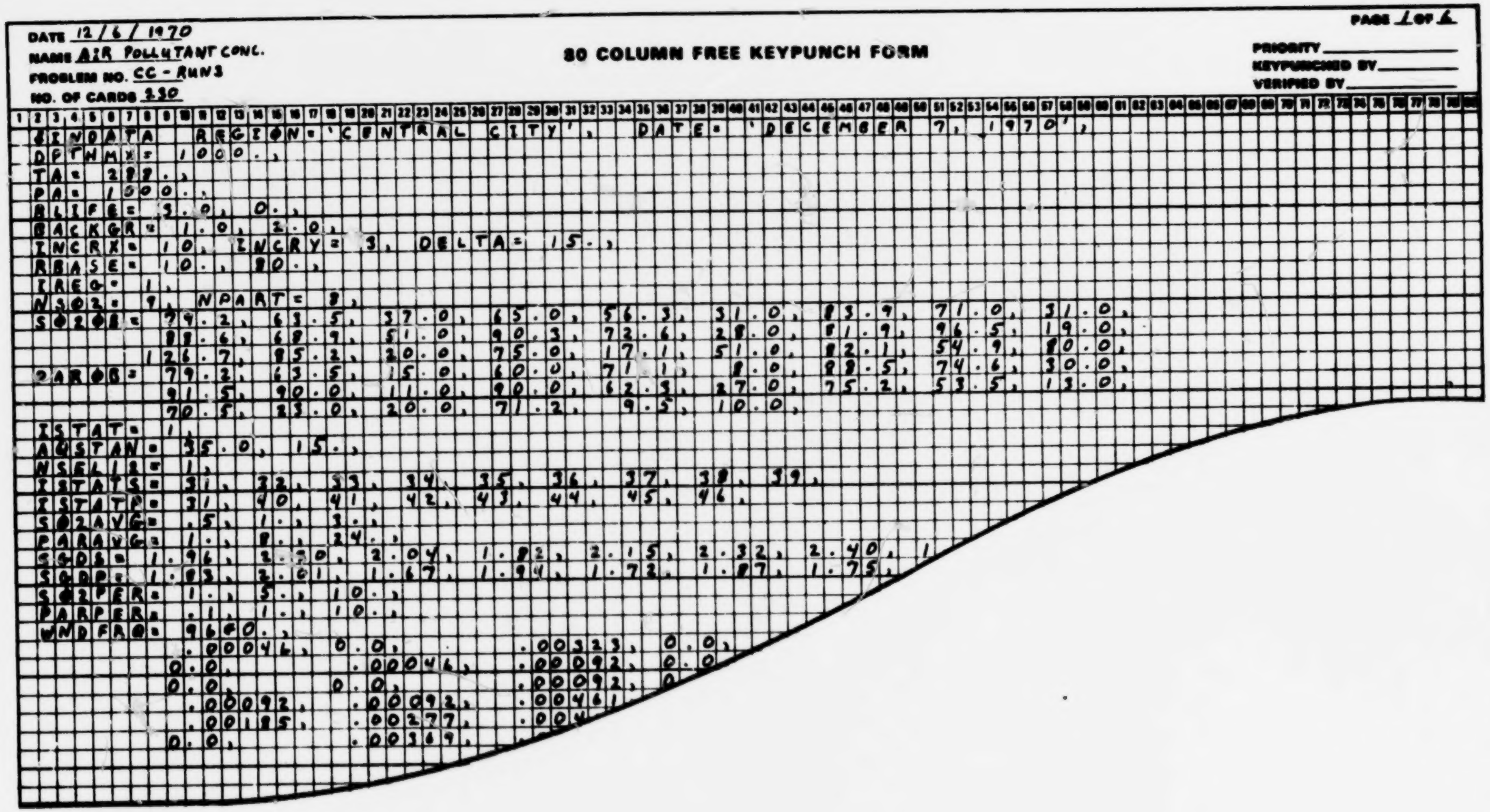
---

*Receptor location numbers are selected from the basic set of input receptors. The numbering system of the basic set is defined as follows: first number the grid receptor locations consecutively, increasing from bottom to top within each column and by column from left to right; then number the non-grid receptors, continuing from the last grid receptor number in the order they are input. The basic set will then contain INCRX*INCRY + IADD receptor numbers.

TABLE 7.3-1

PUNCHED CARD INPUT FOR THE AIR POLLUTANT CONCENTRATION PROGRAM (Continued)

Data Type	Description
ONP	S02PER - Three (3) percentile levels (percent) for the SO_2 statistical output.
ONP	PARPER - Three (3) percentile levels (percent) for the particulate matter statistical output.
MN	&END - This variable signifies the end of a list of NAMELIST variables. No values are associated with this variable.



DATE 12/6/1970

NAME AIR POLLUTANT CONC.

PROBLEM NO. CC - RUNS

NO. OF CARDS 330

80 COLUMN FREE KEYPUNCH FORM

PAGE 1 OF 6

PRIORITY ______

KEYPUNCHED BY ______

VERIFIED BY ______

```
 $INDATA   REGION='CENTRAL CITY',  DATE= 'DECEMBER 7, 1970',
 DPTHMX= 1000.,
 TA= 288.,
 PA= 1500.,
 BLIFE= 3.0, 0.,
 BACKGR= 1.0, 2.0,
 INCRX= 10, INCRY= 3, DELTA= 15.,
 RBASE= 10., 80.,
 IREG= 1,
 NSO2= 9, NPART= 8,
 SO2OB= 79.2,  63.5,  37.0,  65.0,  56.3,  31.0,  83.9,  71.0,  31.0,
        88.6,  68.9,  51.0,  90.3,  72.6,  28.0,  81.9,  96.5,  19.0,
       126.7,  85.2,  20.0,  75.0,  17.1,  51.0,  82.1,  54.9,  80.0,
 PAROB= 79.2,  63.5,  15.0,  60.0,  71.1,   8.0,  88.5,  74.6,  30.0,
        91.5,  90.0,  11.0,  90.0,  62.3,  27.0,  75.2,  53.5,  13.0,
        70.5,  83.0,  20.0,  71.2,   9.5,  10.0,
 ISTAT= 1,
 AQSTAN= 35.0, 15.,
 NSELI2= 1,
 ISTATS= 31, 32, 33, 34, 35, 36, 37, 38, 39,
 ISTATP= 31, 40, 41, 42, 43, 44, 45, 46,
 SO2AVG= .5, 1., 3.,
 PARAVG= 1., 8., 24.,
 SGDS= 1.96, 2.30, 2.04, 1.82, 2.15, 2.32, 2.40, 1
 SGDP= 1.83, 2.01, 1.67, 1.94, 1.72, 1.87, 1.75,
 SO2PER= 1., 5., 10.,
 PARPER= .1, 1., 10.,
 WNDFRQ= 9660.,
          .00046,   0.0,          .00323,  0.0,
         0.0,             .00046, .00092,  0.0
         0.0,       0.0,          .00092,  0
          .00092,         .00092, .00461
          .00185,         .00277, .004
         0.0,             .00369,
```

Figure 7.3-4. Example Input Data Form for the Air Pollutant Concentration Program.

```
REGION: CENTRAL CITY                                                                              DATE: DECEMBER 7, 1970

-----------------------------------------------------------------------------------------------------------------------
|                                                    SOURCE DATA                                                        |
|-----------------------------------------------------------------------------------------------------------------------|
| SOURCE | SIC  | SITE | PREC | SOURCE LOCATION | SOURCE |  EMISSION RATE  |  STACK   |  STACK   |   EXIT   |  EXIT   |
| NUMBER | CODE | CODE | CODE |  (KILOMETERS)   |  AREA  |   (TONS/DAY)    |  HEIGHT  | DIAMETER | VELOCITY |  TEMP   |
|        |      |      |      | HORIZ     VERT  | (SQ KM)|  SO2       PART | (METERS) | (METERS) |  (M/SEC) | (DEG K) |
|--------|------|------|------|-----------------|--------|-----------------|----------|----------|----------|---------|
|      1 | 2119 |    1 |  25  |  60.0 |   60.0  |   0.0  |    0.0 |   0.13 |   15.2   |   0.6    |   15.2   |  338.6  |
|      2 | 2800 |   41 |  10  |  68.0 |   71.0  |   0.0  |  25.00 |   4.00 |   24.1   |   2.6    |   17.7   |  483.7  |
|      3 | 2819 |   33 |   2  |  68.3 |   33.8  |   0.0  |  19.10 |   0.26 |   29.9   |   1.9    |   15.2   |  362.0  |
|      4 | 2819 |   34 |   2  |  80.9 |   57.0  |   0.0  |  23.70 |   0.21 |   29.9   |   1.9    |   15.2   |  361.4  |
|      5 | 2819 |   34 |  20  |  80.9 |   57.0  |   0.0  |  20.36 |   3.90 |   24.1   |   2.2    |   17.7   |  500.4  |
|      6 | 2819 |  160 |   3  |  71.5 |   41.7  |   0.0  |    0.0 |  21.90 |   22.9   |   2.1    |   15.2   |  505.4  |
|      7 | 2871 |  260 |   1  |  90.1 |   70.0  |   0.0  |    0.0 |   8.00 |   18.0   |   2.0    |   15.2   |  325.3  |
|      8 | 2911 |   61 |   1  |  97.3 |   90.5  |   0.0  |    0.0 |   0.12 |   29.9   |   7.4    |   15.2   |  811.2  |
|      9 | 2951 |  150 |   1  |  68.0 |   54.3  |   0.0  |    0.0 |   0.97 |   18.0   |   0.9    |   17.7   |  394.2  |
|     10 | 3241 |  100 |   1  |  85.2 |   78.9  |   0.0  |    0.0 |   2.79 |   61.0   |   3.4    |   15.2   |  561.0  |
|     11 | 3295 |   51 |   1  |  83.1 |   91.2  |   0.0  |    0.0 |  19.18 |   11.9   |   2.1    |   17.7   |  294.1  |
|     12 | 3312 |  111 |   1  |  92.1 |   74.2  |   0.0  |    0.0 |   1.00 |   29.9   |   4.5    |   17.7   |  475.9  |
|     13 | 3312 |  111 |   2  |  92.1 |   74.2  |   0.0  |    0.0 |   0.74 |   29.9   |   5.3    |   17.7   |  833.4  |
|     14 | 3312 |  111 |   3  |  92.1 |   74.2  |   0.0  |   0.23 |   0.27 |   29.9   |   3.6    |   17.7   |  444.2  |
|     15 | 3323 |   71 |  30  |  89.6 |   73.9  |   0.0  |   0.80 |   0.10 |   30.8   |   2.2    |   15.2   |  506.0  |
|     16 | 3323 |   71 |  40  |  89.6 |   73.9  |   0.0  |   0.80 |   0.10 |   30.8   |   2.2    |   15.2   |  506.0  |
|     17 | 3323 |   72 |   1  |  89.8 |   74.5  |   0.0  |   0.92 |   1.01 |   29.9   |   0.5    |   17.7   |  449.8  |
|     18 | 3332 |  270 |   1  |  71.8 |   26.4  |   0.0  | 203.00 |   0.31 |   29.9   |   3.2    |   17.7   |  783.4  |
|     19 | 3332 |  270 |   3  |  71.8 |   26.4  |   0.0  |  28.20 |   0.02 |   29.9   |   0.7    |   17.7   |  783.4  |
|     20 | 4911 |    5 |  10  |  75.2 |   99.0  |   0.0  | 192.08 |   1.80 |  121.0   |   6.7    |   15.2   |  439.2  |
|     21 | 4911 |    6 |  20  | 130.0 |   84.5  |   0.0  |   3.57 |   4.20 |  121.0   |   0.9    |   15.2   |  444.8  |
|     22 | 4911 |    7 |  30  |  76.9 |    4.2  |   0.0  | 377.20 |   8.10 |  121.0   | 304.8 *  |   15.2   |  427.6  |
|     23 | 4953 |  130 |   1  |  86.8 |   72.0  |   0.0  |   0.30 |   2.55 |   46.0   |   2.
|     24 | 4953 |  131 |   2  |  76.5 |   70.2  |   0.0  |   0.22 |   0.33 |   14.9   |   0.
|     25 | 4953 |  131 |   4  |  87.0 |   70.0  |   0.0  |   0.00 |   0.28 |   36.6
|     26 | 4953 |  132 |   2  | 129.5 |   83.5  |   0.0  |   0.15 |   0.22 |   1
|     27 | 9999 |   10 |   0  |  42.0 |   10.0  | 400.0  |   0.08 |   0.01 |
|     28 | 9999 |   20 |   0  |  42.0 |   30.0  | 400.0  |   0.17 |   0.
|     29 | 9999 |   30 |   0  |  42.0 |   50.0  | 400.0  |   0.53 |
|     30 | 9999 |   40 |   0  |  42.0 |   70.0  | 400.0  |   0.55
|     31 | 9999 |   50 |   0  |  62.0 |   10.0  | 400.0  |   0.
|     32 | 9999 |   60 |   0  |  62.0 |   10.0  | 400.0  |
|     33 | 9999 |   70 |   0  |  62.0 |   30.0  | 400.0  |
|     34 | 9999 |   80 |   0  |  62.0 |   30.0  | 100.
|     35 | 9999 |   90 |   0  |  62.0 |   50.0  |
|     36 | 9999 |  100 |   0  |  72.0 |   50.0  |
|     37 | 9999 |  110 |   0  |  62.0 |   60.
|     38 | 9999 |  120 |   0  |  72.0 |
|     39 | 9999 |  130 |   0  |  62.0
|     40 | 9999 |  140 |   0  |
|--------|------|------|

* NORMALIZED PLUME RISE VALUE (SQUARE METERS PER SECOND)
```

Figure 7.3-5. Output Format - Source Data

```
REGION: CENTRAL CITY                    DATE: DECEMBER 7, 1970

                         STABILITY WIND ROSE DATA

STABILITY CLASS 3
                                      WIND SPEED CLASS
                   1          2          3          4          5          6
WIND DIRECTION
     N          0.00046    0.0        0.00323    0.0        0.0        0.0
     NNE        0.0        0.00046    0.00092    0.0        0.0        0.0
     NE         0.0        0.0        0.00092    0.0        0.0        0.0
     ENE        0.00092    0.00092    0.00461    0.0        0.0        0.0
     E          0.00185    0.00277    0.00415    0.00046    0.0        0.0
     ESE        0.0        0.00369    0.00461    0.0        0.0        0.0
     SE         0.00138    0.00323    0.00277    0.0        0.0        0.0
     SSE        0.0        0.00277    0.00092    0.0        0.0        0.0
     S          0.0        0.00092    0.00092    0.0        0.0        0.0
     SSW        0.0        0.00185    0.00092    0.0        0.0        0.0
     SW         0.0        0.00185    0.00092    0.0        0.0        0.0
     WSW        0.00046    0.00138    0.00092    0.0        0.0        0.0
     W          0.0        0.00138    0.00092    0.0        0.0        0.0
     WNW        0.00046    0.00046    0.00092    0.0        0.0        0.0
     NW         0.0        0.00092    0.00046    0.0        0.0        0.0
     NNW        0.0        0.00138    0.00138    0.0        0.0        0.0
```

Figure 7.3-6. Output Format - Stability Wind Rose Data.

moderately unstable, slightly unstable, neutral, and stable conditions, respectively. For each stability class (i.e., on any given page), the frequency of occurrence of each of the 6 wind speed classes (0-3, 4-6, 7-10, 11-16, 17-21 and over 21 knots) is listed for each of the 16 wind directions. The sum of these frequency values for all stability classes (480 values) equals unity.

Regional Data (Figure 7.3-7)

This data consists of the input temperature, pressure, mixing height, pollutant half-life values and pollutant background values. The "INFINITE" notation for half-life indicates the input data was less than .5 hours.

Correlation Data (Figure 7.3-8)

A separate Correlation Data table is printed for each pollutant, giving the station number, location, and annual arithmetic average concentration at ground level. The table lists the observed (input minus background) concentration and estimated concentration as computed by the program at each of the input monitoring stations. The data in these two columns is used by the program to compute the regression parameters used for calibration. Only the last column contains values computed by the program. Data in the other columns is input and displayed here to allow comparison of observed and computed concentrations at each location, as in the development of the calibration curves. If input regression line constants are used, these tables will not appear.

Regression Parameters (Figure 7.3-9)

This output is a summary of the results of the calibration of the model for the specific region. Two parameters for each pollutant (y-intercept and slope) are shown. These values define the best (least-squares fit) linear equation describing the relationship between calculated and observed concentrations. In addition to these parameters, a computed regression coefficient shown. When the value of the computed coefficient is greater than that of the 5% confidence level, calibration is considered to be satisfactory. Each equation is then used by the computer program to adjust the air quality values as dictated by the calibration.

```
REGION: CENTRAL CITY                                  DATE: DECEMBER 7, 1970

    ------------------------------------------------------------------
                              REGIONAL DATA
    ------------------------------------------------------------------

      AMBIENT TEMPERATURE (DEGREES KELVIN)                     =    288.0

      AMBIENT PRESSURE (MILLIBARS)                             =   1000.0

      MIXING HEIGHT (METERS)                                   =   1000.0

      HALF LIFE (HOURS) FOR:
                                   SO2                         =      3.0
                                   PARTICULATES                = INFINITE

      BACKGROUND CONCENTRATION (MICROGRAMS/CUBIC METER) FOR:
                                   SO2                         =      1.0
                                   PARTICULATES                =      2.0
```

Figure 7.3-7. Output Format - Regional Data.

NOT REPRODUCIBLE

```
REGION: CENTRAL CITY                                    DATE: DECEMBER 7, 1972

 -----------------------------------------------------------------------------
|                         CORRELATION DATA FOR SO2                            |
 -----------------------------------------------------------------------------
| MONITORING | STATION LOCATION    | ARITHMETIC MEAN CONCENTRATION            |
|  STATION   |  (KILOMETERS)       |  (MICROGRAMS/CUBIC METER)                |
|  NUMBER    |  HORIZ      VERT    |  OBSERVED *            COMPUTED          |
 -----------------------------------------------------------------------------
|            |          |          |                   |                      |
|     1      |   79.2   |   63.5   |       36.0        |        40.6          |
|     2      |   65.0   |   56.3   |       30.0        |        23.2          |
|     3      |   83.9   |   71.0   |       30.0        |        32.8          |
|     4      |   88.6   |   68.9   |       50.0        |        62.0          |
|     5      |   90.3   |   72.6   |       27.0        |        24.0          |
|     6      |   51.9   |   96.5   |       18.0        |         6.9          |
|     7      |  126.8   |   85.2   |       19.0        |         2.8          |
|     8      |   75.0   |   17.1   |       50.0        |        58.2          |
|     9      |   82.1   |   54.9   |       79.0        |        93.6          |
 -----------------------------------------------------------------------------

* OBSERVED = INPUT MEASURED VALUE - INPUT BACKGROUND VALUE
```

Figure 7.3-8. Output Format - Correlation Data.

NOT REPRODUCIBLE

```
REGION: CENTRAL CITY                                                DATE: DECEMBER 7, 1970

------------------------------------------------------------------------------------------------
|                                  REGRESSION PARAMETERS                                        |
------------------------------------------------------------------------------------------------
| POLLUTANT     | Y-INTERCEPT | SLOPE  |   REGRESSION COEFFICIENTS   |         COMMENT          |
|               |             |        |   COMPUTED     5% CONF. LEVEL |                          |
------------------------------------------------------------------------------------------------
|    SO2        |    12.62    | 0.6550 |   0.98447     |   0.66600   | STATISTICALLY SIGNIFICANT |
| PARTICULATES  |    -2.32    | 1.3200 |   0.99341     |   0.70700   | STATISTICALLY SIGNIFICANT |
------------------------------------------------------------------------------------------------

IF "NOT STATISTICALLY SIGNIFICANT".....THE COMPUTED SLOPE AND Y-INTERCEPT ARE NOT USED FOR CALIBRATION
```

Figure 7.3-9 Output Format - Regression Parameters.

When the computed value of the regression coefficient is less than that corresponding to the 5% confidence level, the following note will be printed in the Table: NOT STATISTICALLY SIGNIFICANT. When this occurs, the air quality values at receptors will be printed without the use of these regression constants. It should also be noted that in this case the regression parameters should not be used in subsequent runs. Instead, the reason for the poor correlation should be determined and the necessary corrections made. If input regression line parameters are used, no confidence level values are obtained. If the run is "Calibrate Only" the run will terminate with this table.

Receptor Concentration Data (Figure 7.3-10)

The primary output of the Air Pollutant Concentration Program is contained in this output. Each grid and non-grid receptor is listed on a separate line, by receptor number, together with the location and ground-level concentration for each pollutant as computed by the program. The term "expected" in the heading over the last three columns is not used in the strict statistical sense, but merely indicates that the values are predictions or estimates made by the program.

If calibration was requested and was successful (i.e., the calculated regression coefficient exceeded the 5% confidence level), the values printed in this table will have been adjusted using the regression-line parameters.

Pollutant Concentration Above Standard (Figure 7.3-11)

This table repeated for each pollutant, lists those receptors at which the ground level concentration exceeds the input ambient air quality standard. Each line of data in this table applies only to the Receptor Number indicated for that line. For example, the "Necessary Reduction for Point Sources" values in the first line is the required percent reduction of all point source emissions to reduce the mean concentration of receptor number 39 to the input ambient air quality standard of 35.0 micrograms per cubic meter.

Statistical Data for Selected Receptors (Figure 7.3-12)

A statistical data table is printed for each pollutant and averaging-time combination. In each table, data for the specified receptors consists

```
REGION: CENTRAL CITY                      DATE: DECEMBER 7, 1973

-----------------------------------------------------------------------
|                    RECEPTOR CONCENTRATION DATA                      |
|---------------------------------------------------------------------|
| RECEPTOR |  RECEPTOR LOCATION  |  EXPECTED ARITHMETIC MEAN          |
|  NUMBER  |    (KILOMETERS)     |  (MICROGRAMS/CUBIC METER)          |
|          |  HORIZ      VERT    |     SO2               PART         |
|----------|---------------------|------------------------------------|
|          |          |          |                 |                  |
|     1    |   10.0   |   90.0   |      15.8       |       4.6        |
|     2    |   10.0   |   95.0   |      15.5       |       4.1        |
|     3    |   10.0   |  110.0   |      15.2       |       3.4        |
|     4    |   25.0   |   80.0   |      16.8       |       5.5        |
|     5    |   25.0   |   95.0   |      16.2       |       4.6        |
|     6    |   25.0   |  110.0   |      15.7       |       3.7        |
|     7    |   40.0   |   80.0   |      18.3       |       6.8        |
|     8    |   40.0   |   95.0   |      17.0       |       5.4        |
|     9    |   40.0   |  110.0   |      16.5       |       4.1        |
|    10    |   55.0   |   80.0   |      20.7       |       8.1        |
|    11    |   55.0   |   95.0   |      18.3       |       6.9        |
|    12    |   55.0   |  110.0   |      18.1       |       4.6        |
|    13    |   70.0   |   80.0   |      24.1       |      10.2        |
|    14    |   70.0   |   95.0   |      18.8       |      11.4        |
|    15    |   70.0   |  110.0   |      18.2       |       4.8        |
|    16    |   85.0   |   80.0   |      25.1       |      19.1        |
|    17    |   85.0   |   95.0   |      18.4       |      13.0        |
|    18    |   85.0   |  110.0   |      15.7       |       4.5        |
|    19    |  100.0   |   80.0   |      17.4       |       6.1        |
|    20    |  100.0   |   95.0   |      16.2       |       4.2        |
|    21    |  100.0   |  110.0   |      15.0       |       2.7        |
|    22    |  115.0   |   80.0   |      15.4       |       3.5        |
|    23    |  115.0   |   95.0   |      14.9       |       2.4        |
|    24    |  115.0   |  110.0   |      14.5       |       1.7        |
|    25    |  130.0   |   80.0   |      15.6       |       4.9        |
|    26    |  130.0   |   95.0   |      14.5       |       1.8        |
|    27    |  130.0   |  110.0   |      14.1       |       1.1        |
|    28    |  145.0   |   80.0   |      14.3       |       1.8        |
|    29    |  145.0   |   95.0   |      14.0       |       1.1        |
|    30    |  145.0   |  110.0   |      13.9       |       0.7        |
|    31    |   79.2   |   63.5   |      40.2       |      15.0        |
|    32    |   65.0   |   56.3   |      26.8       |      12.0        |
|    33    |   83.9   |   71.0   |      35.1       |      23.3        |
|    34    |   88.6   |   68.9   |      54.3       |      37.8        |
|    35    |   90.3   |   72.6   |      29.3       |      29.5        |
|    36    |   61.9   |   95.5   |      18.1       |      15.9        |
|    37    |  126.8   |   35.2   |      15.4       |       4.3        |
|    38    |   75.0   |   17.1   |      51.6       |      12.4        |
|    39    |   92.1   |   54.9   |      74.9       |      20.1        |
|    40    |   60.0   |   71.1   |      24.3       |       9.7        |
|----------|----------|----------|-----------------|------------------|
```

Figure 7.3-10. Output Format - Receptor Concentration Data.

NOT REPRODUCIBLE

```
REGION: CENTRAL CITY                                                                              DATE: DECEMBER 7, 1970

--------------------------------------------------------------------------------------------------------------------------
|                      SO2 POLLUTANT CONCENTRATIONS ABOVE STANDARD OF  35.00 MICROGRAMS PER CUBIC METER                  |
|-------------------------------------------------------------------------------------------------------------------------|
|          |               POLLUTANT CONCENTRATION (MICROGRAMS PER CUBIC METER)              | POLLUTANT REDUCTION (PERCENT) |
|          |---------------------------------------------------------------------------------|-------------------------------|
| RECEPTOR |                  |                  |                  |                  | NECESSARY FOR  | NECESSARY FOR |
|  NUMBER  | ARITHMETIC MEAN  | EXCESS ABOVE AIR | CONTRIBUTION FROM| CONTRIBUTION FROM| POINT SOURCES  |  ALL SOURCES  |
|          |  CONCENTRATION   | QUALITY STANDARD |  POINT SOURCES   |  AREA SOURCES    |                |               |
|----------|------------------|------------------|------------------|------------------|----------------|---------------|
|    39    |     74.9389      |     39.9389      |     65.7918      |      8.1471      |    60.7050     |    53.2953    |
|    45    |     57.4016      |     22.4016      |     54.5275      |      1.8742      |    41.0832     |    39.0261    |
|    34    |     54.2545      |     19.2545      |     47.0652      |      6.1893      |    40.9102     |    35.4892    |
|    46    |     54.1853      |     19.1853      |     52.0067      |      1.1786      |    36.8901     |    35.4068    |
|    38    |     51.7652      |     16.7652      |     49.0558      |      1.7095      |    34.1759     |    32.3871    |
|    31    |     40.2053      |      5.2053      |     26.4182      |     12.7870      |    19.7034     |    12.9468    |
|    41    |     36.7519      |      1.7519      |     29.8707      |      5.8812      |     5.8650     |     4.7668    |
|    33    |     35.0978      |      0.0978      |     27.3831      |      6.7147      |     0.3570     |     0.2785    |
--------------------------------------------------------------------------------------------------------------------------
```

Figure 7.3-11. Output Format - Pollutant Concentration Above Standard.

NOT REPRODUCIBLE

```
REGION: CENTRAL CITY                                                                  DATE: DECEMBER 7, 1970

AVERAGING TIME =     1.0 HOURS

 ----------------------------------------------------------------------------------------------------------------
|                                                                                                                |
|          PARTICULATE STATISTICAL DATA AT SELECTED RECEPTORS (MICROGRAMS PER CUBIC METER)                       |
|                                                                                                                |
|----------------------------------------------------------------------------------------------------------------|
| SELECTED | EXPECTED   | EXPECTED  |     0.10      |     1.00      |    10.00      |  EXPECTED -   | STANDARD  |
| RECEPTOR | ARITHMETIC | GEOMETRIC |  PERCENTILE   |  PERCENTILE   |  PERCENTILE   |   MAXIMUM     | GEOMETRIC |
|  NUMBER  |    MEAN    |   MEAN    | CONCENTRATION | CONCENTRATION | CONCENTRATION | CONCENTRATION | DEVIATION |
|----------|------------|-----------|---------------|---------------|---------------|---------------|-----------|
|    31    |   14.99    |   11.31   |    114.87     |     64.78     |     29.59     |    197.57     |   2.12    |
|    40    |    9.71    |    6.68   |     97.11     |     50.11     |     20.26     |    181.79     |   2.38    |
|    41    |   30.14    |   24.62   |    175.95     |    108.22     |     55.65     |    278.77     |   1.89    |
|    42    |   13.30    |    7.35   |     93.31     |     49.79     |     21.08     |    169.11     |   2.28    |
|    43    |   27.53    |   22.04   |    176.39     |    105.50     |     52.21     |    286.96     |   1.96    |
|    44    |   12.38    |    9.16   |    101.04     |     55.83     |     24.79     |    177.19     |   2.17    |
|    45    |   18.65    |   14.65   |    125.34     |     73.75     |     35.69     |    207.19     |   2.00    |
|    46    |   10.20    |    7.09   |     99.25     |     51.70     |     21.18     |    184.04     |   2.35    |
 ----------------------------------------------------------------------------------------------------------------
```

Figure 7.3-12. Output Format - Statistical Data at Selected Receptors.

of: the expected arithmetic mean (used here in the sense of predicted or estimated arithmetic mean) from the program; the standard geometric deviation, which is the input value converted to the desired averaging time; and the expected geometric mean and expected maximum concentration values, which are calculated from the expected arithmetic mean and standard geometric deviation values. Again, if calibration of the model was requested and was successful, the arithmetic mean values used in this calculation will have been adjusted using the regression line parameters. In addition, this output lists the expected ground-level concentrations at three input percentile values (other than the maximum value).

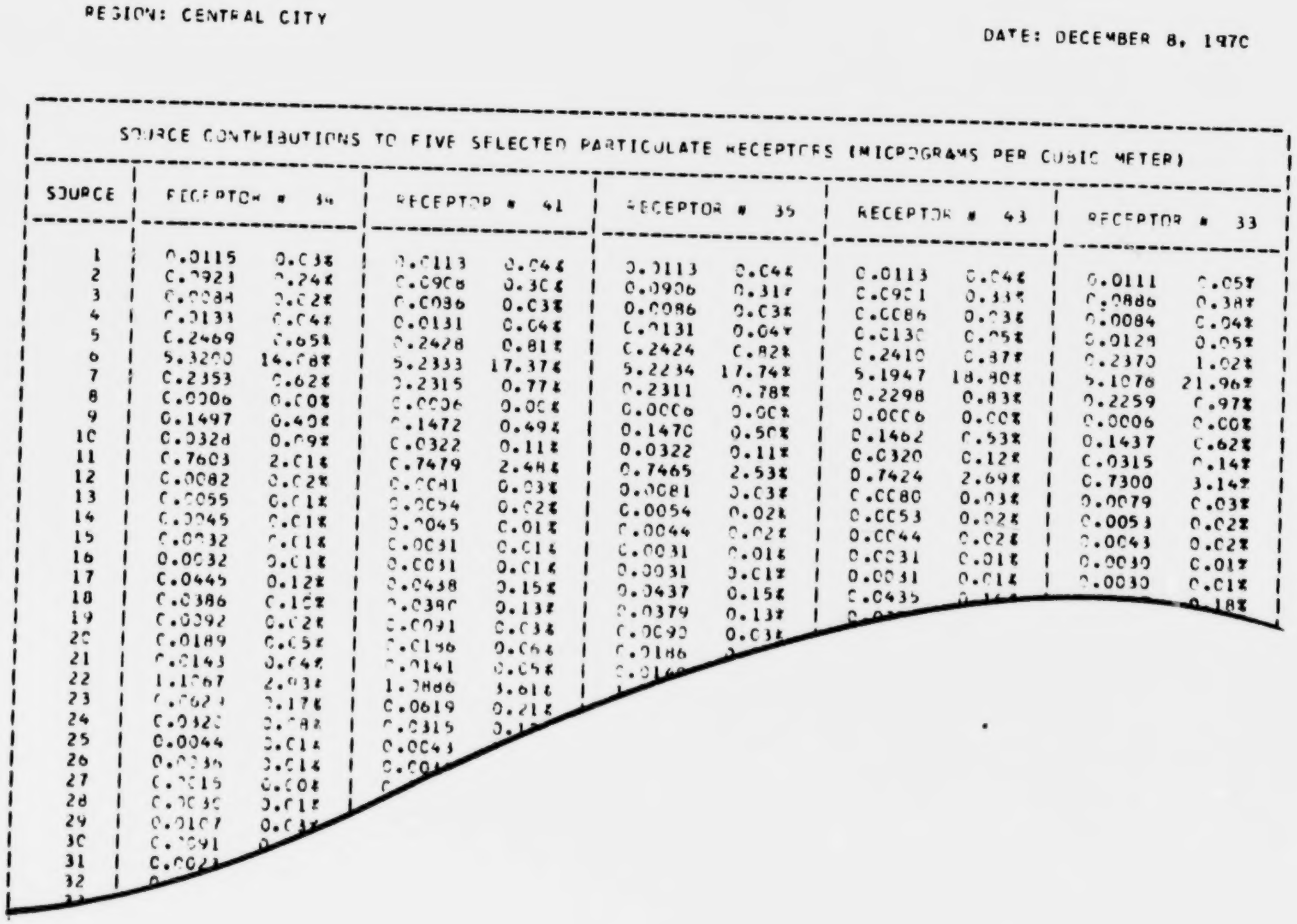
Source Contribution to Five Selected (or Maximum) Receptors (Figure 7.3-13)

The contributions of each point and area source in the region to the five selected or five maximum receptors (as requested by the user) are output for each pollutant. The source numbers correspond to those used in the Source Data Table (Figure 7.3-5).

The contribution of a given source to each receptor is indicated both as a percentage of the total concentration at the receptor and as an absolute value (microgram/cubic meter). The contribution of the background concentration, which is constant throughout the region, is shown in the second line from the bottom. The last line contains the total contribution from all sources for each receptor. Since all source contributions and background values are summed, the percentage figure will total 100% and the absolute value will equal the total concentration at each receptor (i.e., the last figure in each receptor column will be the same as that in the Receptor Concentration Data Table (Figure 7.3-10).

Punched Card Output (Table 7.3-2)

The data printed in the Receptor Concentration Data Table (Figure 7.3-4) is also punched on cards for use with surface contour programs. The Air Pollutant Concentration Program provides only the punched cards; a separate computer program is required to generate contour (isopleth) maps. Since many of the surface contour programs utilize input data in integer form, the emission rate values are scaled by a factor of 100.



```
REGION: CENTRAL CITY                                                                                DATE: DECEMBER 8, 1970

---------------------------------------------------------------------------------------------------------------------------
|      SOURCE CONTRIBUTIONS TO FIVE SELECTED PARTICULATE RECEPTORS (MICROGRAMS PER CUBIC METER)                            |
---------------------------------------------------------------------------------------------------------------------------
| SOURCE |  RECEPTOR #  34   |  RECEPTOR #  41   |  RECEPTOR #  35   |  RECEPTOR #  43   |  RECEPTOR #  33   |
|--------|-------------------|-------------------|-------------------|-------------------|-------------------|
|    1   |  0.0115    0.03%  |  0.0113    0.04%  |  0.0113    0.04%  |  0.0113    0.04%  |  0.0111    0.05%  |
|    2   |  0.0923    0.24%  |  0.0908    0.30%  |  0.0906    0.31%  |  0.0901    0.33%  |  0.0886    0.38%  |
|    3   |  0.0084    0.02%  |  0.0096    0.03%  |  0.0086    0.03%  |  0.0086    0.03%  |  0.0084    0.04%  |
|    4   |  0.0133    0.04%  |  0.0131    0.04%  |  0.0131    0.04%  |  0.0130    0.05%  |  0.0129    0.05%  |
|    5   |  0.2469    0.65%  |  0.2428    0.81%  |  0.2424    0.82%  |  0.2410    0.87%  |  0.2370    1.02%  |
|    6   |  5.3200   14.08%  |  5.2333   17.37%  |  5.2234   17.74%  |  5.1947   18.80%  |  5.1078   21.96%  |
|    7   |  0.2353    0.62%  |  0.2315    0.77%  |  0.2311    0.78%  |  0.2298    0.83%  |  0.2259    0.97%  |
|    8   |  0.0006    0.00%  |  0.0006    0.00%  |  0.0006    0.00%  |  0.0006    0.00%  |  0.0006    0.00%  |
|    9   |  0.1497    0.40%  |  0.1472    0.49%  |  0.1470    0.50%  |  0.1462    0.53%  |  0.1437    0.62%  |
|   10   |  0.0328    0.09%  |  0.0322    0.11%  |  0.0322    0.11%  |  0.0320    0.12%  |  0.0315    0.14%  |
|   11   |  0.7603    2.01%  |  0.7479    2.48%  |  0.7465    2.53%  |  0.7424    2.69%  |  0.7300    3.14%  |
|   12   |  0.0082    0.02%  |  0.0081    0.03%  |  0.0081    0.03%  |  0.0080    0.03%  |  0.0079    0.03%  |
|   13   |  0.0055    0.01%  |  0.0054    0.02%  |  0.0054    0.02%  |  0.0053    0.02%  |  0.0053    0.02%  |
|   14   |  0.0045    0.01%  |  0.0045    0.01%  |  0.0044    0.02%  |  0.0044    0.02%  |  0.0043    0.02%  |
|   15   |  0.0032    0.01%  |  0.0031    0.01%  |  0.0031    0.01%  |  0.0031    0.01%  |  0.0030    0.01%  |
|   16   |  0.0032    0.01%  |  0.0031    0.01%  |  0.0031    0.01%  |  0.0031    0.01%  |  0.0030    0.01%  |
|   17   |  0.0445    0.12%  |  0.0438    0.15%  |  0.0437    0.15%  |  0.0435    0.1              0.18%  |
|   18   |  0.0386    0.10%  |  0.0390    0.13%  |  0.0379    0.13%  |  0.0
|   19   |  0.0092    0.02%  |  0.0091    0.03%  |  0.0090    0.03%  |
|   20   |  0.0189    0.05%  |  0.0186    0.06%  |  0.0186    0
|   21   |  0.0143    0.04%  |  0.0141    0.05%  |  0.014
|   22   |  1.1067    2.93%  |  1.0886    3.61%  |
|   23   |  0.0623    0.17%  |  0.0619    0.21%  |
|   24   |  0.0320    0.08%  |  0.0315    0.1
|   25   |  0.0044    0.01%  |  0.0043
|   26   |  0.0036    0.01%  |  0.00
|   27   |  0.0015    0.00%  |  0
|   28   |  0.0030    0.01%  |
|   29   |  0.0107    0.03%
|   30   |  0.0091    0
|   31   |  0.002
|   32   |  0
```

Figure 7.3-13. Output Format - Source Contributions to Five Receptors.

NOT REPRODUCIBLE

TABLE 7.3-2

PUNCHED CARD FORMAT FOR OUTPUT CONCENTRATION DATA DECK

Column	Description
1-8	Location X (km)
9-16	Location Y (km)
17-23	SO_2 Concentration (10^2 micrograms/cubic meter
24-29	Particulate Concentration (10^2 micrograms/cubic meter)

7.4 SOURCE CONTRIBUTION FILE MERGE PROGRAM

7.4.1 Description

The function of this program is to merge the Source Contribution Files (Sub-region Files), produced by multiple Air Pollutant Concentration Program runs, into a single file for use by the Regional Strategies Program. No printed output is associated with this program. The contents of the Source Contribution File are shown in Table 7.4-1.

7.4.2 JCL and Deck Setup

Figure 7.4-1 illustrates the JCL inputs for the following situation:

(a) Four Source Contribution Files to be merged.

(b) All files are on magnetic tape.

(c) Source Contribution File Merge Program is stored on magnetic tape.

The file, as defined by the specifications in Figure 7.4-1, has a 52 byte record size which is variable blocked and a block size of 1044 bytes with 20 records/block. The user should note that a file may utilize several magnetic tapes; thus the merged file may not be on a single tape. For regions with less than 150,000 source receptor combinations, however, the merged file, if blocked properly, may be contained on a single tape.

7.4.3 Input

The program merges two files at a time; therefore, for more than two Source Contribution files, multiple job steps must be run. Figure 7.4-2 illustrates the merge flow for four input files going from tape to tape. As the files are merged, the receptor numbers of the second, third,--,etc., files will be changed to produce a continuous receptor numbering system on the output file. Since the receptor numbering system may be required by the user (for statistical output selection in the Regional Strategies Program), the file merge order should be noted for future reference. Then, if needed, the numbering system on the merged file can be determined by the user.

TABLE 7.4-1

SOURCE CONTRIBUTION FILE

First Record	Words
Number of Receptors	1
Number of Sources	1
Date of Run	5
Background Concentration, SO_2	1
Background Concentration Particulate	1
Y-intercept, SO_2 Calibration	1
Y-intercept, Particulate Calibration	1
Slope, SO_2 Calibration	1
Slope, Particulate Calibration	1
	13
Receptor Records	
X Coordinate	1
Y Coordinate	1
Receptor Number	1
	3
Source Records	
SIC Number	1
Site and Process Number	1
Political Jurisdiction	1
Source Contribution SO_2	1
Source Contribution Particulate	1
	5

```
FIRST MERGE STEP:

//       EXEC PGM=TRWTAPE1
//STEPLIB  DD DSN=USER.LINKLIB,DISP=SHR
//GO.FT06F001 DD SYSOUT=A

    FIRST INPUT TAPE(S) (11) DATA SET:

//GO.FT11FC01  DD  UNIT=2400,DSN=CINCY1,DISP=(OLD,PASS),
//  DCB=(BLKSIZE=524,LRECL=52,RECFM=VBS,BUFNO=1),LABEL=(.NL.,IN),
//       VOL=SER=(0005)

    SECOND INPUT TAPE(S)  (12)  DATA SET:

//GO.FT12F001  DD  UNIT=2400,DSN=CINCY2, DISP=(OLD,PASS),
//  DCB=(BLKSIZE=524,LRECL=52,RECFM=VBS,BUFNO=1),LABEL=(.NL.,IN),
//       VOL=SER=(0674)

    FIRST OUTPUT TAPE(S)  (01)  DATA SET:
//GO,FT13F001  DD  UNIT=2400,DSN=TRWMC-01,DISP=(NEW,PASS),
//  DCB=(BLKSIZE=524,LRECL=52,RECFM=VBS,BUFNO=1),
//   LABEL=(,SL,,OUT)

SECOND MERGE STEP:

//       EXEC  PGM=TRWTAPE1
//STEPLIB  DD  DSN=USER.LINKLIB,DISP=SHR
//GO.FT06F001  DD  SYSOUT=A

    FIRST OUTPUT TAPE(S)  (01) AS INPUT DATA SET:

//GO.FT11F001  DD  UNIT=2400,DSN-TRWMC-01,DISP=(OLD,PASS),
//               LABEL=(,SL,,IN)

    THIRD INPUT TAPE(S)  (13)  DATA SET:

//GO.FT12FC01  DD  UNIT=2400,DSN=CINCY3,DISP=(OLD,PASS),
// DCB=(BLKSIZE=1924,LRECL=192,RECFM=VBS,BUFNO=1),LABEL=(.NL.,IN),
//      VOL=SER=(0936)

    SECOND OUTPUT TAPE(S)  (02)  DATA SET:

//GO.FT13F001  DD  UNIT=2400,DSN=TRWMC-02,DISP=(NEW,PASS),
// DCB=(BLKSIZE=524,LRECL=52,RECFM=VBS,BUFNO=1),
//  LABEL=(,SL,,OUT)
```

Figure 7.4-1. Example JCL Card Setup for the Source Contribution File Merge Program.

```
FINAL MERGE STEP:

//        EXEC  PGM=TRWTAPE1
//STEPLIB  DD   DSN=USER.LINKLIB,DISP=SHR
//GO.FT06F001  DD  SYSOUT=A

    SECOND OUTPUT TAPE(S)  (02) AS INPUT DATA SET:

//GO.FT11F001  DD  UNIT=2400,DSN=TRWMC-02,DISP=(OLD,PASS),
//               LABEL=(,SL,,IN)

    FOURTH INPUT TAPE(S)  (14)  DATA SET:

//GO.FT12F001  DD  UNIT=2400,DSN=CINCY4,DISP=(OLD,PASS),
// DCB=(BLKSIZE=524,LRECL=52,RECFM=VBS,BUFNO=1),LABEL=(,NL,,IN),
//       VOL=SER=(1556)

    FINAL OUTPUT TAPE(S) DATA SET:

//GO.FT13F001  DD  UNIT=2400,DSN=TRWSCCIN,DISP=(NEW,KEEP),
// DCB=(RECFM=VBS,BLKSIZE=524,LRECL=52,BUFNO=1),
// LABEL=(,SL,,OUT)
```

Figure 7.4-1. Example JCL Card Setup for the Source Contribution File Merge Program. (Continued)

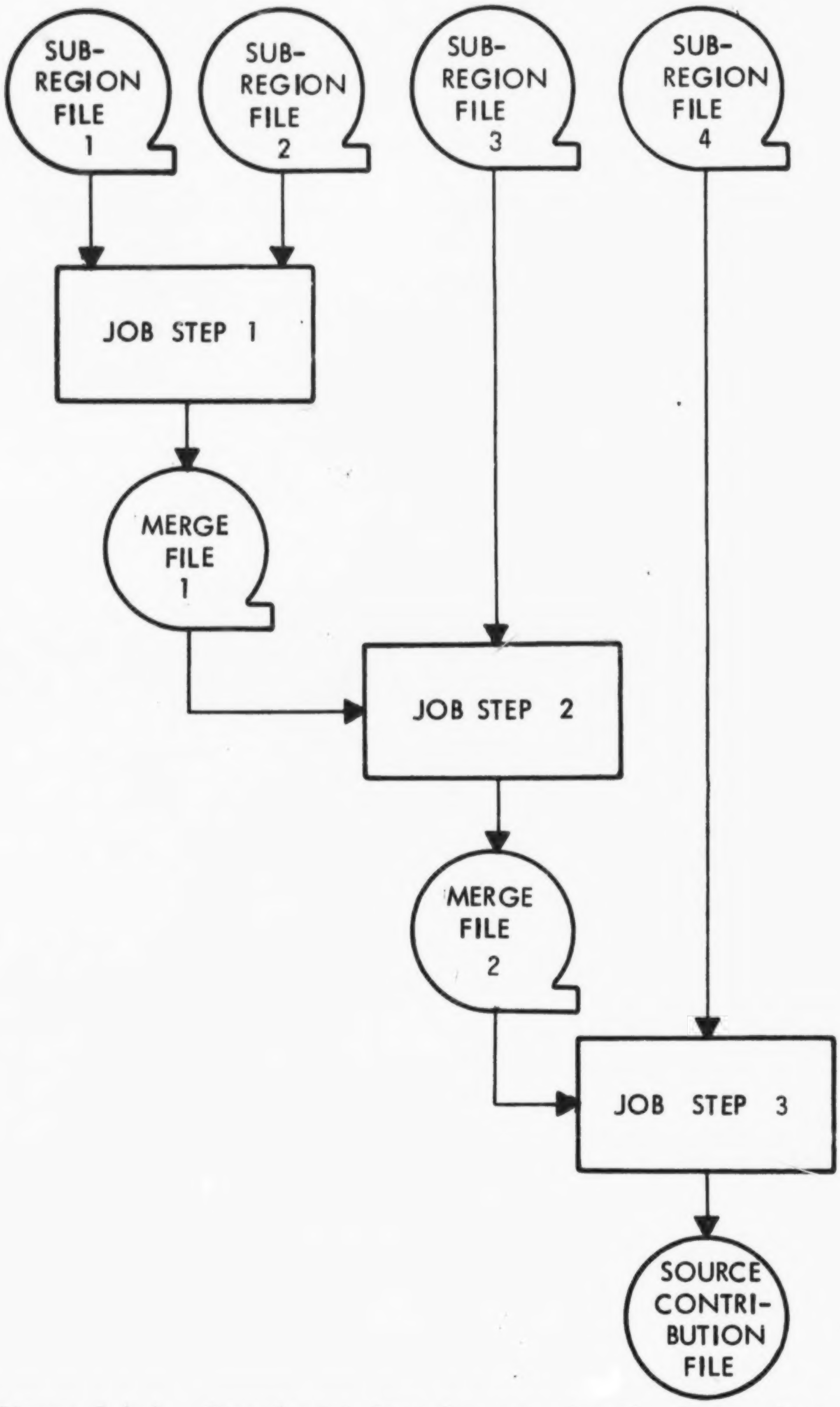

SUB-REGION FILE 1
SUB-REGION FILE 2
SUB-REGION FILE 3
SUB-REGION FILE 4
JOB STEP 1
MERGE FILE 1
JOB STEP 2
MERGE FILE 2
JOB STEP 3
SOURCE CONTRIBUTION FILE

Figure 7.4-2. Example Job Step Sequence for the Source Contribution File Merge Program.

7.4.4 Output

A single Source Contribution File comprises the output from this program. There are no file list or error message function available. However, if a given input file is unreadable, a systems error will be produced.

7.5 CONTROL COST PROGRAM

The Control Cost Program utilizes point source data from the Source File and user created punched card input. The Source File data elements are listed in Table 7.2-2. The punched card input is described in this section.

7.5.1 Description

The function of the program is to produce cost data and new source characteristics resulting from application of various control devices to each point source defined in the region. Figure 7.5-1 illustrates the fundamental sequence of operations. For each point source, the program will determine the applicability of each control device defined within the program. The applicable devices are applied, producing new source characteristics and device related cost data. In this way a file (Control Cost File) and printed output are created containing the desired data. Detailed descriptions of the data manipulations for this program are given in Chapter 5.

7.5.2 JCL and Deck Setup

An example deck setup configuration is illustrated in Figure 7.5-2. Figure 7.5-3 contains the specific JCL cards, corresponding to Figure 7.5-2, which were used for the installation test case setup. The test setup assumed the following:

(a) Control Cost program in object deck form

(b) Program Overlay Structure is Used (see Volume II, Section 3.4)

(c) Source Data File is on disk.

Deviations from this configuration require appropriate JCL card changes.

7.5.3 Input

The punched card input variables used to construct the Data Set are given in Table 7.5-1. An example data form is shown in Figure 7.5-4. Three types of inputs must be considered: Regional Data, Control Device Data, and Device Applicability Data.

(a) Regional Data - must be input for each run

(b) Control Device Data - pre-set in the program but may be changed by input. There are 50 device numbers defined in the program. The particular devices for which data has been pre-set are shown in Table 7.5-2.

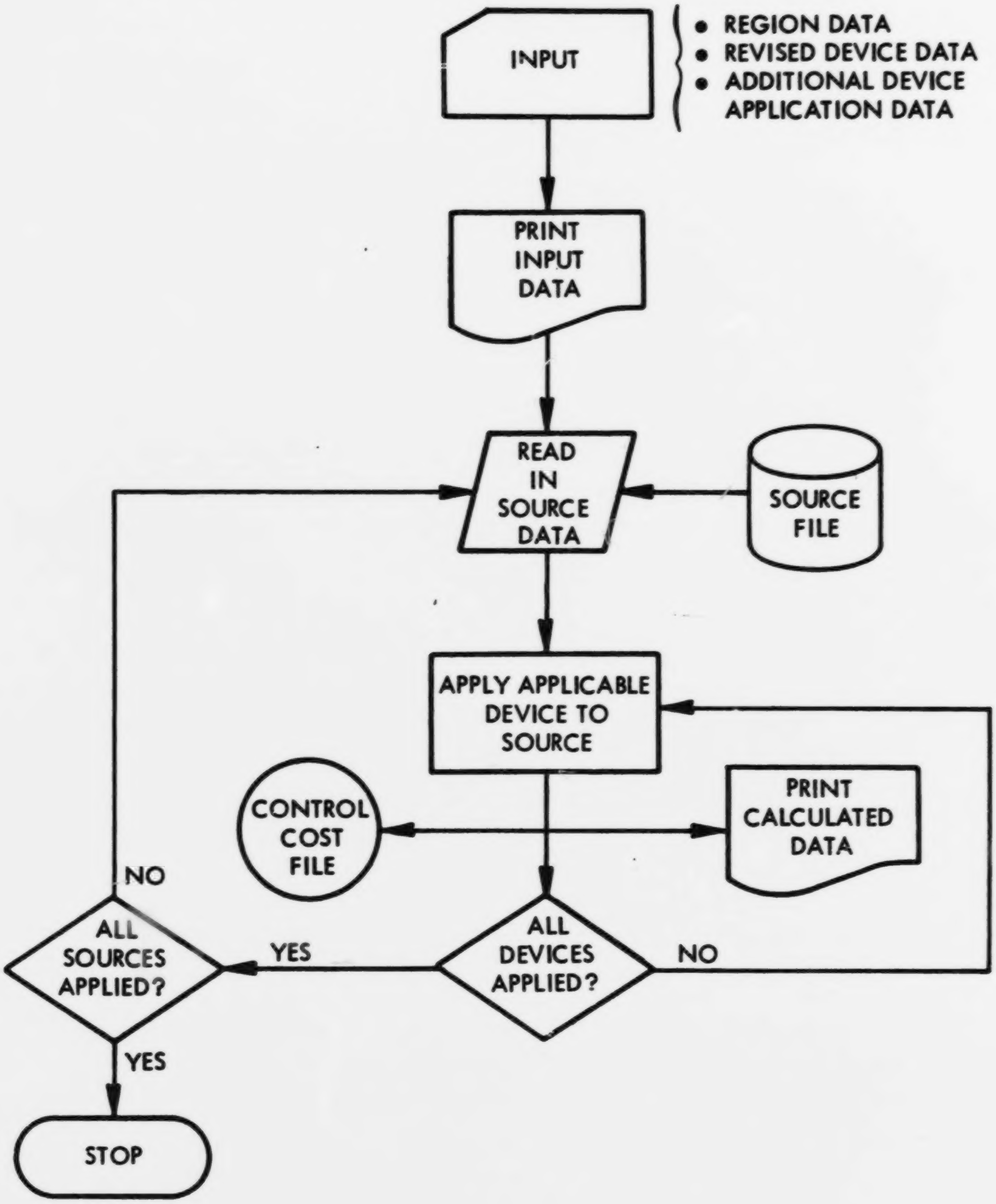

INPUT
• REGION DATA
• REVISED DEVICE DATA
• ADDITIONAL DEVICE APPLICATION DATA
PRINT INPUT DATA
READ IN SOURCE DATA
SOURCE FILE
APPLY APPLICABLE DEVICE TO SOURCE
CONTROL COST FILE
PRINT CALCULATED DATA
NO
ALL SOURCES APPLIED?
YES
ALL DEVICES APPLIED?
NO
YES
STOP

Figure 7.5-1. Control Cost Program Flow.

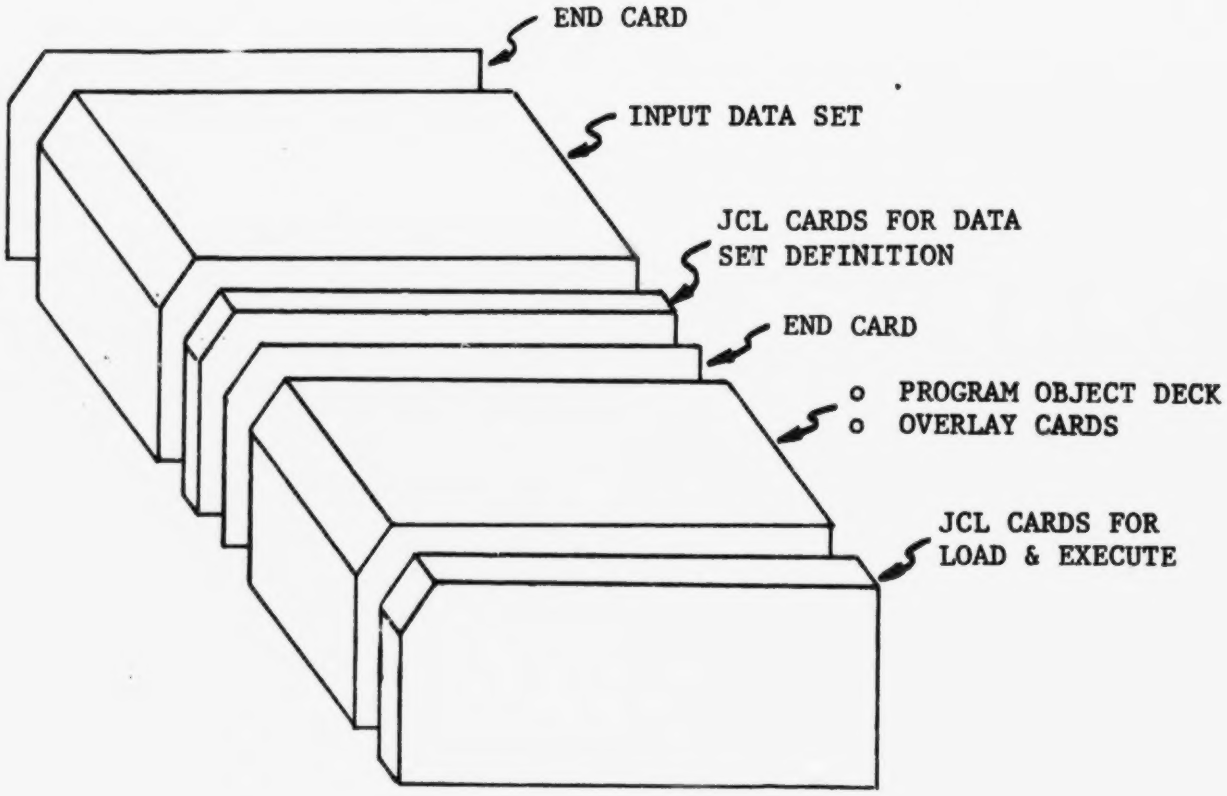

END CARD
INPUT DATA SET
JCL CARDS FOR DATA SET DEFINITION
END CARD
o PROGRAM OBJECT DECK
o OVERLAY CARDS
JCL CARDS FOR LOAD & EXECUTE

Figure 7.5-2. Example Deck Configuration for the Control Cost Program.

```
                                COST MODEL EXECUTION

LOAD AND       { //COST  EXEC FORTGLG,PARM.LKED=(OVLY,LET,XREF,LIST)
EXECUTE        { //LKED.SYSIN DD *
               {                        OBJECT DECK
               {
               {  OVERLAY A
               {  INSERT WSOUR
               {  OVERLAY A
PROGRAM        {  INSERT DEVAPL,WDEVAR
OBJECT DECK    {  OVERLAY A
AND OVERLAY    {  INSERT WDEVR
CARDS.         {  OVERLAY A
               {  INSERT WREGR
               {  OVERLAY A
               {  INSERT EXDEVC
END CARD.        /*
               { //GO.FT12F001 DD DSN=NEWSORCE,UNIT=2314,VOL=SER=000078,
               { //               DISP=(OLD,KEEP),
               { //               DCB=(RECFM=VB,LRECL=225,BLKSIZE=229)
               { //GO.FT14F001 DD DSN=COSTO,UNIT=2400,
DATA SET       { //               DISP=(NEW,PASS),
DEFINITION     { //               DCB=(RECFM=VBS,LRECL=136,BLKSIZE=140)
               { //GO.FT13F001 DD DSN=CMEPR,UNIT=2400,
               { //              DISP=(NEW,KEEP),
               { //               DCB=(RECFM=F,BLKSIZE=133)
               { //GO.SYSIN DD *

DATA SET                                   DATE CARD AND NAMELIST DATA

END CARD         /*
```

Figure 7.5-3. Example JCL Card Setup for the Control Cost Program.

TABLE 7.5-1

PUNCHED CARD INPUT FOR CONTROL COST PROGRAM

Data Type		Description	
MF		Date Card, completed as follows:	
	Column	Card Data	Format
	1-20	Run Date	Left Justified
	21	Device flag; set to 1 if NAMELIST device data is present	
	22	Device applicability flag; set to 1 if NAMELIST device applicability data is present	
MN		&REGREC - a NAMELIST variable indicating start of NAMELIST inputs for the regional cost and fuel data. No equal sign or values are associated with this variable.	
MNA		RNAM - descriptive name of the region. Up to 20 characters may be used (preceded by an apostrophe and followed by an apostrophe and comma).	
MNI		IREGR - number of the region for which this set of data is being input (must correspond with the Region Number used in the Source File).	
MNP		RATE - interest rate applicable to the region (percent).	
MNP		XLHR - labor cost for the region ($/hour).	
MNP		ELCS - electricity costs ($/kw hour). Input in the order of: cost to industrial plants, cost to power plants, and cost to commercial plants.	
MNP		FLIQS - water cost ($/gallon).	
MNP		AFCØST(1,1,1) - regional cost for coal ($/ton). Input in the order: cost of grade 1 to industrial plants, cost of grade 1 to power plants, cost of grade 1 to commercial plants, cost of grade 2 to industrial plants, -----, cost of grade 5 to commercial plants.	

TABLE 7.5-1

PUNCHED CARD INPUT FOR CONTROL COST PROGRAM (Continued)

Data Type	Description
MNP	AFCØST(1,1,2) - regional cost for residual oil ($/gallon). Input in the order: cost of grade 1 to industrial plants, cost of grade 1 to power plants, cost of grade 1 to commercial plants, cost of grade 2 to industrial plants, -----, cost of grade 5 to commercial plants.
MNP	AFCØST(1,1,3) - regional cost for distillate oil ($/gallon). Input in the order: cost of grade 1 to industrial plants, cost of grade 1 to power plants, cost of grade 1 to commercial plants, cost of grade 2 to industrial plants, -----, cost of grade 3 to commercial plants.
MNP	AFCØST(1,1,4) - regional cost for gas ($/cubic foot). Input in the order: cost to industrial plants, cost to power plants, cost to commercial plants.
MNP	AFSCC - lower and upper limits (percent) of sulfur content for each grade of coal. Input in the order: grade 1 lower limit, grade 1 upper limit, grade 2 lower limit, grade 2 upper limit, -----, grade 5 upper limit.*
MNP	AFSCR - lower and upper limits (percent) of sulfur content for each grade of residual oil. Input in the order: grade 1 lower limit, grade 1 upper limit, grade 2 lower limit, grade 2 upper limit, -----, grade 5 upper limit.
MNP	AFSCD - lower and upper limits (percent) of sulfur content for each grade of distillate oil. Input in the order: grade 1 lower limit, grade 1 upper limit, grade 2 lower limit, grade 2 upper limit, grade 3 lower limit, grade 3 upper limit.

---

* For each fuel grade, the sulfur content range includes all values greater than the lower limit and less than or equal to the upper limit.

TABLE 7.5-1

PUNCHED CARD INPUT FOR CONTROL COST PROGRAM (Continued)

Data Type	Description
MNP	AFSCG - gas sulfur content (percent).
MNP	AFHC(1,1) - Heat content for fuel grade 1. Input in the order: coal (BTU/ton) residual oil (BTU/gal), distillate oil (BTU/gal), gas (BTU/cubic foot).
MNP	AFHC(1,2) - Heat content for fuel grade 2. Input in the order: coal, residual oil, distillate oil.
MNP	AFHC(1,3) - Heat input for fuel grade 3. Input in the order: coal, residual oil, distillate oil.
MNP	AFHC(1,4) - Heat input for fuel grade 4. Input in the order: coal, residual oil.
MNP	AFHC(1,5) - Heat input for fuel grade 5. Input in the order: coal, residual oil.
MNP	SLIM - maximum allowable sulfur content (percent) for devices 030, 031 and 032. Input in the order: device 030 coal sulfur limit, device 030 residual oil sulfur limit, device 030 distillate oil sulfur content, device 031 coal sulfur limit, device 031 residual oil sulfur content, -----, device 032 distillate oil sulfur content.
MNP	AFAC - Coal ash content (percent) for each grade. Input in the order: grade 1, grade 2, grade 3, grade 4, and grade 5.
MNP	&END - this variable indicates the end of a list of NAMELIST inputs.
ON*	&DEVREC - a NAMELIST input variable indicating the start of NAMELIST inputs for the device inputs.

---

*If device data is input (Device Flag = 1) this card and the &END card are mandatory.

TABLE 7.5-1

PUNCHED CARD INPUT FOR CONTROL COST PROGRAM (Continued)

Data Type	Description
	For the following device data variables (up to the next &END card), I must be set equal to the device number (1 through 50) for which the input applies. Each such variable may be repeated as input for as many different device numbers as desired.
ONI	DEVNAM (1,I) - descriptive name for device I. Up to 24 characters may be used (preceded by an apostrophe and followed by an apostrophe and comma). All 24 characters must be contained on one card.
ONP	XMP1(I) - manufacturers price coefficient number 1 for device I.
ONP	XMP2(I) - manufacturers price coefficient number 2 for device I.
ONP	XMP3(I) - manufacturers price coefficient number 3 for device I.
ONP	CINCST(I) - installation cost factor (percent), for device I.
ONP	FLF(I) - device life (years) for device I.
ONP	PRDRØ - pressure drop (inches H_2O) for device I.
ONP	QLAB(1,I) - labor quantity (hours), associated with device I, for various plant sizes. Input is in the order: labor quantity for small plant, labor quantity for medium plant, labor quantity for large plant, labor quantity for extra large plant.
ONP	CATS(I) - chemical cost ($/ton) for device I.
ONP	DCØC(1,1) - disposal cost or credit ($/ton), associated with device I, for each pollutant. Input in the order: SO_2 cost or credit, particulate matter cost or credit.
ONP	DFUELF(I) - device fuel factor for device I.
ONP	REFFSØ(I) - rated efficiency (percent) for SO_2 removal, device I.
ONP	REFFPT(I) - rated efficiency (percent) for particulate removal, device I.

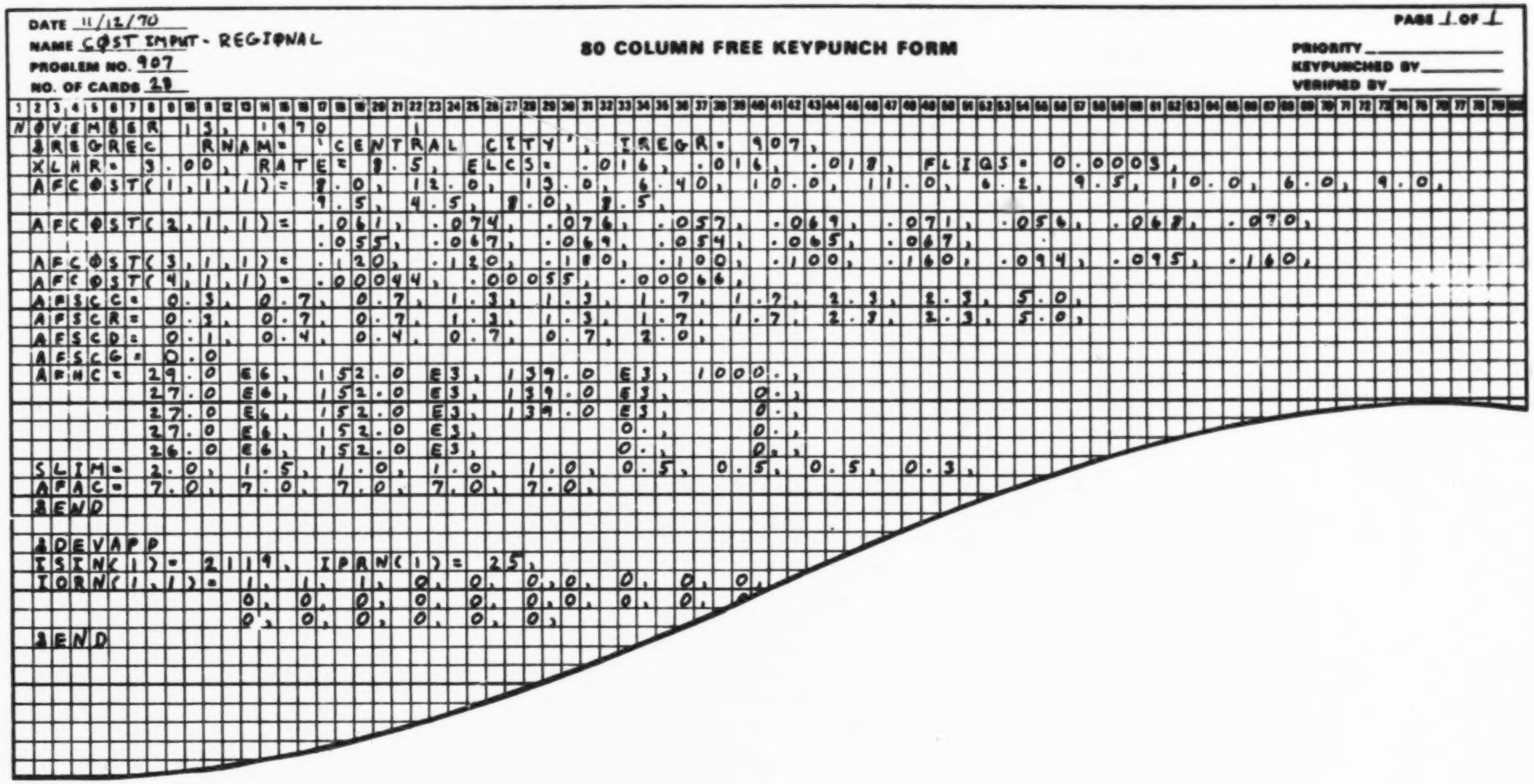
TABLE 7.5-1

PUNCHED CARD INPUT FOR CONTROL COST PROGRAM (Continued)

Data Type	Description
ON	&END - a NAMELIST variable indicating the end of the NAMELIST data.
ON	&DEVAPP - a NAMELIST variable indicating the start of NAMELIST inputs for additions to the device applicability list. No equal sign or values are associated with this variable.

The following three device applicability variables must be input for each additional SIC-Process code input. In each case I must equal the number of the input (i.e., I = 1 for first additional code, I = 2 for second additional, ---, I = 5 for fifth additional code). A maximum of five additional codes may be input. The input data must be ordered such that the I value used in each set is in ascending order.

Data Type	Description
ONI	ISIN(I) - SIC number for addition I.
ONI	IPRN(I) - Process code for addition I.
ONI	IORN(1,I) - array indicating device application for addition I. An applicability indicator must be input for each of the 50 possible control devices. Input 1 if device applies, 0 if device does not apply.
ON	&END - this NAMELIST variable indicates the end of the NAMELIST data.



DATE 11/12/70

NAME CØST INPUT - REGIØNAL

PROBLEM NO. 907

NO. OF CARDS 28

80 COLUMN FREE KEYPUNCH FORM

PAGE 1 OF 1

PRIORITY

KEYPUNCHED BY

VERIFIED BY

```
NØVEMBER 13,  1970
 $REGREC  RNAM= 'CENTRAL CITY', IREGR= 907,
 XLHR= 3.00, RATE= 8.5, ELCS= .016, .016, .018, FLIQS= 0.0003,
 AFCØST(1,1,1)= 8.0, 12.0, 13.0, 6.40, 10.0, 11.0, 6.2, 9.5, 10.0, 6.0, 9.0,
                9.5, 4.5, 8.0, 8.5,
 AFCØST(2,1,1)= .061, .074, .076, .057, .069, .071, .056, .068, .070,
                .055, .067, .069, .054, .065, .067,
 AFCØST(3,1,1)= .120, .120, .180, .100, .100, .160, .094, .095, .160,
 AFCØST(4,1,1)= .00044, .00055, .00066,
 AFSCC= 0.3, 0.7, 0.7, 1.3, 1.3, 1.7, 1.7, 2.3, 2.3, 5.0,
 AFSCR= 0.3, 0.7, 0.7, 1.3, 1.3, 1.7, 1.7, 2.3, 2.3, 5.0,
 AFSCD= 0.1, 0.4, 0.4, 0.7, 0.7, 2.0,
 AFSCG= 0.0
 AFHC= 29.0 E6, 152.0 E3, 139.0 E3, 1000.,
       27.0 E6, 152.0 E3, 139.0 E3,    0.,
       27.0 E6, 152.0 E3, 139.0 E3,    0.,
       27.0 E6, 152.0 E3,      0.,     0.,
       26.0 E6, 152.0 E3,      0.,     0.,
 SLIM= 2.0, 1.5, 1.0, 1.0, 1.0, 0.5, 0.5, 0.5, 0.3,
 AFAC= 7.0, 7.0, 7.0, 7.0, 7.0,
 $END

 $DEVAPP
 ISIN(1)= 2119, IPRN(1)= 25,
 IORN(1,1)= 1, 1, 1, 0, 0, 0,0, 0, 0, 0,
            0, 0, 0, 0, 0, 0,0, 0, 0, 0,
            0, 0, 0, 0, 0, 0,
 $END
```

Figure 7.5-4. Example Input Data Form for the Control Cost Program

TABLE 7.5-2

CONTROL DEVICE PRESET DATA

ID	Device Name	Rated Efficiency		Manufacturers Price Coefficient			Install Factor	Chemical Cost	Disposal Cost		Labor Quantity				Device Life	Pressure Drop	Fuel Factor
		SO_2	Part	1	2	3			SO_2	Part	SML	MED	LGE	X-LG			
1	WET SCRUBBER HI EFFIC	0.0	98.0	0.289E 01	0.228E 00	0.0	2.00	0.0	0.0	1.0	0.50	1.00	2.00	4.00	15	20	0.0
2	WET SCRUBBER MED EFFIC	0.0	90.0	0.289E 01	0.228E 00	0.0	2.00	0.0	0.0	1.0	0.38	0.75	1.50	3.00	15	4	0.0
3	WET SCRUBBER LOW EFFIC	0.0	80.0	0.126F 01	0.145E 00	0.0	2.00	0.0	0.0	1.0	0.38	0.75	1.50	3.00	15	3	0.0
4	GRAV COLLECTOR HI EFFIC	0.0	60.0	-0.445E 00	0.326E 00	0.0	1.00	0.0	0.0	1.0	0.25	0.50	1.00	2.00	15	0	0.0
5	GRAV COLLECTOR MED EFFIC	0.0	40.0	-0.420E-01	0.155E 00	0.0	1.00	0.0	0.0	1.0	0.25	0.50	1.00	2.00	15	0	0.0
6	GRAV COLLECTOR LOW EFFIC	0.0	30.0	0.300E-02	0.560E-01	0.0	1.00	0.0	0.0	1.0	0.25	0.50	1.00	2.00	15	0	0.0
7	CYCLONE HI EFFIC	0.0	85.0	0.241E 01	0.197E 00	0.0	1.00	0.0	0.0	1.0	0.25	0.50	1.00	2.00	15	4	0.0
8	CYCLONE MED EFFIC	0.0	75.0	0.151E 01	0.157E 00	0.0	1.00	0.0	0.0	1.0	0.25	0.50	1.00	2.00	15	3	0.0
9	CYCLONE LOW EFFIC	0.0	60.0	0.244E 00	0.990E-01	0.0	1.00	0.0	0.0	1.0	0.25	0.50	1.00	2.00	15	2	0.0
10	ELECT PRECIP HI EFFIC	0.0	99.0	0.424E 02	0.623E 00	0.0	1.00	0.0	0.0	1.0	0.50	1.50	3.00	6.00	15	0	0.0
11	ELECT PRECIP MED EFFIC	0.0	95.0	0.312E 02	0.441E 00	0.0	1.00	0.0	0.0	1.0	0.50	1.50	3.00	6.00	15	0	0.0
12	ELECT PRECIP LOW EFFIC	0.0	90.0	0.197E 02	0.318E 00	0.0	1.00	0.0	0.0	1.0	0.50	1.50	3.00	6.00	15	0	0.0
13	GAS SCRUBBER	80.0	80.0	0.317E 01	0.251E 00	0.0	2.00	10.0	0.0	0.0	0.38	0.75	1.50	3.00	15	5	0.0
14	MIST ELIMINATOR HI VEL	0.0	99.0	0.266E 01	0.325E 00	0.0	1.00	0.0	0.0	0.0	0.25	0.50	1.00	2.00	15	10	0.0
15	MIST ELIMINATOR LOW VEL	0.0	85.0	0.177E 01	0.217E 00	0.0	1.00	0.0	0.0	1.0	0.25	0.50	1.00	2.00	15	5	0.0
16	FABRIC FILTER HI TEMP	0.0	99.0	0.145E 01	0.831E 00	0.0	1.00	0.0	0.0	1.0	0.50	1.25	2.50	5.00	15	5	0.0
17	FABRIC FILTER MED TEMP	0.0	99.0	0.348E 01	0.448E 00	0.0	1.00	0.0	0.0	1.0	0.50	1.25	2.50	5.00	15	5	0.0
18	FABRIC FILTER LOW TEMP	0.0	99.0	0.266E 01	0.325E 00	0.0	1.00	0.0	0.0	0.0	0.50	1.25	2.50	5.00	15	5	0.0
19	CATALYTIC AFTERBURNER	0.0	95.0	0.755E 01	0.151E 01	0.0	1.00	0.0	0.0	0.0	0.25	0.50	1.00	2.00	15	1	0.49
20	CATALYTIC AB WITH HE	0.0	95.0	0.755E 01	0.151E 01	0.0	2.00	0.0	0.0	0.0	0.25	0.50	1.00	2.00	15	1	0.24
21	DIRECT FLAME AFTERBURNER	0.0	95.0	0.571E 01	0.117E 01	0.0	1.00	0.0	0.0	0.0	0.13	0.25	0.50	1.00	15	1	1.00
22	DIRECT FLAME AB WITH HE	0.0	95.0	0.571E 01	0.117E 01	0.0	2.00	0.0	0.0	0.0	0.13	0.25	0.50	1.00	15	1	0.40
27	ELIMINATE COAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.0
28	ELIMINATE COAL AND R OIL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.0
29	SWITCH TO GAS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.0
30	SULFUR LIMITATION 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.0
31	SULFUR LIMITATION 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.0
32	SULFUR LIMITATION 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.0
39	CATALYTIC OXIDATION	90.0	0.0	-0.124E 02	0.167E 01	0.0	0.0	0.0	-27.6	0.0	0.0	0.0	0.0	0.0	15	41	0.0
41	DRY LIMESTONE INJECTION	50.0	0.0	0.0	0.995E-06	-0.603E-16	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	15	0	0.0
42	WET LIMESTONE INJECTION	80.0	98.0	0.111E-05	0.481E-16	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	15	0	0.0
43	H2504 PLANT-CONTACT	97.5	0.0	0.0	0.800E 00	0.0	0.0	0.0	-27.6	0.0	0.0	0.0	0.0	0.0	20	0	0.0
44	H2504 PLANT-2 CONTACT	99.5	0.0	0.0	0.800E 00	0.0	0.0	0.0	-27.6	0.0	0.0	0.0	0.0	0.0	20	0	0.0
45	SULFUR PLANT	95.0	0.0	0.0	0.810E 00	0.0	0.0	0.0	-15.0	0.0	0.0	0.0	0.0	0.0	20	0	0.0

Only the devices shown in this table may be changed. The remaining device numbers are for program expansion and require a program modification.

(c) Device Applicability Data - up to 5 new SIC-process codes may be added to the program to account for those new SIC-process codes in the Source File but not shown in Tables 5-2 and 5-3. For each new code input, the applicability (i.e., yes or no) of each of the numbered devices (all 50) must be input. Note, however, that only those device numbers included in Table 7.5-2 may be indicated as applicable.

The procedure required for application of the devices not shown in Table 7.5-2 is as follows:

(a) Add control device data through NAMELIST inputs described in this section.

(b) Make program change to device applicability table (represented by Table 5-2) and the program assignment procedure to allow new devices to be assigned to appropriate SIC-process codes.

7.5.4 Output

Output from the Control Cost Program consists of printed and stored (magnetic tape) data. The stored data is defined as the Control Cost File and is used by the Emission Standards Program. The contents of this file are described in Section 7.6.

The printed data consists of the following items:

Header Data (Figure 7.5-5)

The header data contains the program name, the input region number and description. The input run date, and the update from the Source File (or create data if no file update was performed).

Regional Data (Figure 7.5-5)

This output displays the input regional cost data, alternate fuel data, and maximum allowable sulfur content to be applied as devices 030, 031 and 032. The percent sulfur content range for each grade of fuel includes all values greater than the minimum value and less than or equal to the maximum value. The Heat Content and Fuel Content units are tons of coal, gallons of oil and cubic feet of gas.

```
                        CONTROL COST PROGRAM   REGION: 907 CENTRAL CITY

                   RUN DATE NOVEMBER 13, 1970      SOURCE DATE NOVEMBER 12, 1970
                                                                                  DATE:  NOVEMBER 13, 1970
         REGION:  CENTRAL CITY                 REGIONAL DATA

                 LABOR COST ($/HR) = 3.00   WATER COST ($/GAL) =  0.2E-03   INTEREST RATE (%) =  8.5
ELEC COST PW PLNT ($/KWH) =  0.160E-01   ELEC COST INDUST ($/KWH) =  0.160E-01  ELEC COST COMM  ($/KWH) =  0.180E-01

                                               FUEL DATA TABLE
                              %SULF CONT   HEAT CONT        %ASH            FUEL COST ($/UNIT)
            __FUEL___   GRADE  _MAX _MIN   (BTU/UNIT)       CONT      PWR_PLNT  _INDUST_  __COMM__

            COAL          1     0.7  0.3    0.290E 08       7.0       0.80E 01  0.12E 02  0.13E 02
                          2     1.3  0.7    0.270E 08       7.0       0.64E 01  0.10E 02  0.11E 02
                          3     1.7  1.3    0.270E 08       7.0       0.62E 01  0.95E 01  0.10E 02
                          4     2.3  1.7    0.270E 08       7.0       0.60E 01  0.90E 01  0.95E 01
                          5     5.0  2.3    0.260E 08       7.0       0.45E 01  0.80E 01  0.85E 01

            RESID OIL     1     0.7  0.3    0.152E 06                 0.61E-01  0.74E-01  0.76E-01
                          2     1.3  0.7    0.152E 06                 0.57E-01  0.69E-01  0.71E-01
                          3     1.7  1.3    0.152E 06                 0.56E-01  0.68E-01  0.70E-01
                          4     2.3  1.7    0.152E 06                 0.55E-01  0.67E-01  0.69E-01
                          5     5.0  2.3    0.152E 06                 0.54E-01  0.65E-01  0.67E-01

            DIST OIL      1     0.4  0.1    0.139E 06                 0.12E 00  0.12E 00  0.18E 00
                          2     0.7  0.4    0.139E 06                 0.10E 00  0.10E 00  0.16E 00
                          3     2.0  0.7    0.139E 06                 0.94E-01  0.95E-01  0.16E 00

            GAS           1     0.0         0.100E 04                 0.44E-03  0.55E-03  0.66E-03

                              MAXIMUM ALLOWABLE SULFUR CONTENT (%)
                                            DEVICE NO
                                 __FUEL__     _30_  _31_  _32_

                                 COAL          2.0   1.0   0.5
                                 RESID OIL     1.5   1.0   0.5
                                 DIST OIL      1.0   0.5   0.3
```

Figure 7.5-5. Output Format - Regional Data.

Device Data (Figure 7.5-6)

This data consists of the pre-set device data (Table 7.5-2) as altered by the input device data.

Device Application Criteria for New Source Types (Figure 7.5-7)

This output displays the user input SIC-Process codes and their device application criteria.

Control Cost Data (Figure 7.5-8)

This output contains the program generated data and the data being passed from the Source File to Emission Standards Program. The "Source ID" line contains the following data, as obtained from the Source File:

- Source Identification - SIC, Site, and Process codes.
- Source Type - B (fuel combustion), P (industrial process), or S (solid waste).
- Political Jurisdiction
- Existing SO_2 Emission Rate (ton/day)
- Existing Particulate Emission Rate (ton/day)
- Existing Device Efficiency for SO_2 (percent)
- Existing Device Efficiency for Particulates (percent)
- Boiler Rated Capacity (BTU/hour)
- Maximum Process Rate (pounds/hour)
- Shifts
- Heat Content of Existing Coal (BTU/ton)
- Heat Content of Existing Residual Oil (BTU/gallon)
- Heat Content of Existing Distillate Oil (BTU/gallon)
- Heat Content of Existing Gas (BTU/cubic foot)
- Use Factor
- Normalized Plume Rise (square feet/second)

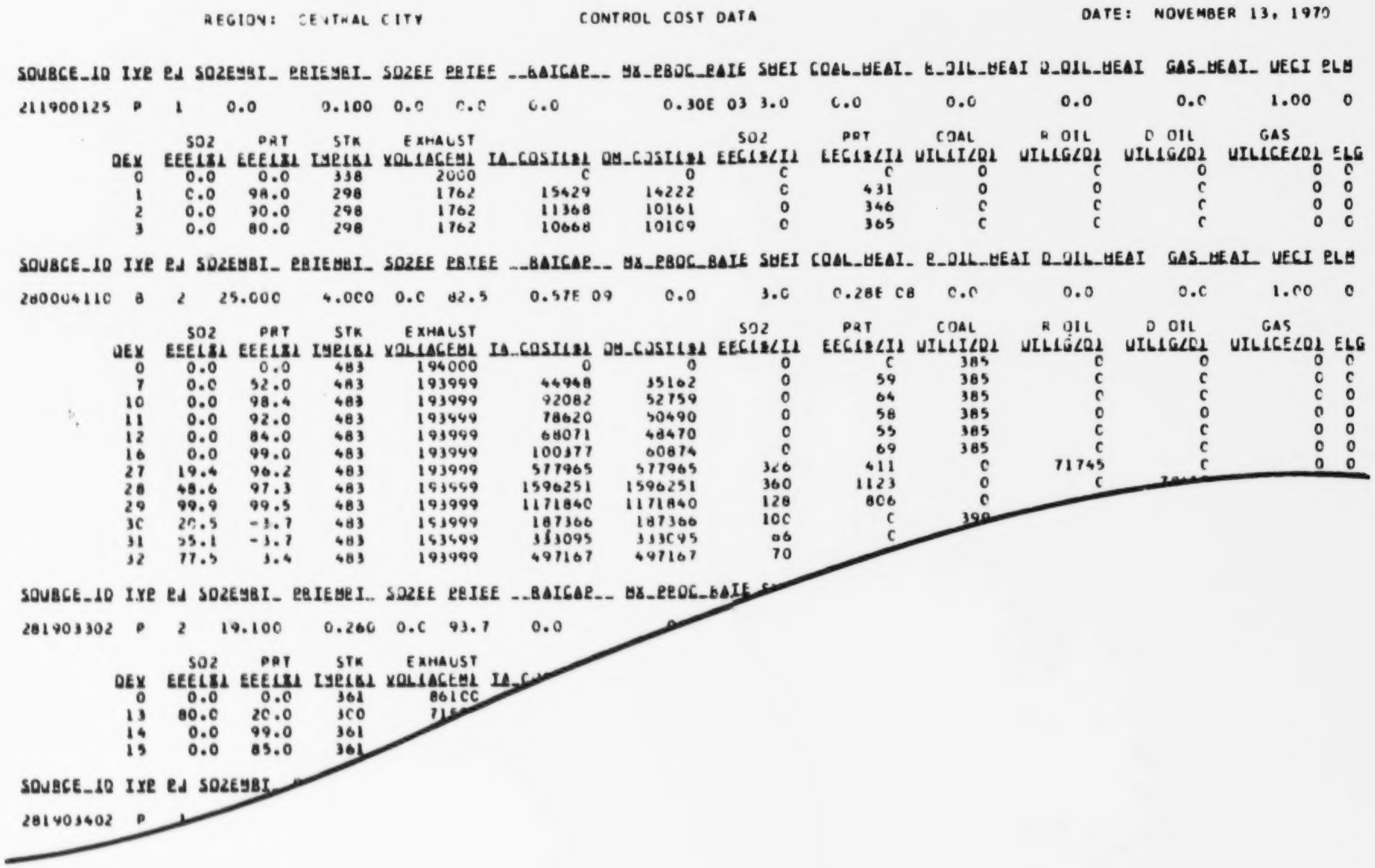
The "DEV" line is repeated for each device applied to the source described on the Source ID line. A device identification (DEV column) of "0" indicates that no new device was applied; therefore, the DEV = 0 line contains the existing conditions: Stack Temperature, Exhaust Gas Volume, and Fuel Utilized. The last column in the DEV line indicates the use of gas cooling (1 = yes, 0 = no).

```
               REGION:  CENTRAL CITY                  DEVICE DATA                                         DATE:  NOVEMBER 13, 1970

                                    RATED EFF     MANUFACTURERS PRICE COEFF       INST CHEM  DISP COST    LABOR QUANTITY        DEV PRS FUEL
 ID ____DEVICE NAME________         _SO2 PART   ____1____ ____2_____ ____3_____ FACT COST __SO2 _PART  SML_ MED_ LGE_ X-LG  LIFE DROP FACT

  1 WET SCRUBBER HI EFFIC           0.0 98.0    0.289E 01  0.228E 00  0.0        2.00  0.0    0.0   1.0  0.50 1.00 2.00 4.00   15  20 0.0
  2 WET SCRUBBER MED EFFIC          0.0 90.0    0.289E 01  0.228E 00  0.0        2.00  0.0    0.0   1.0  0.38 0.75 1.50 3.00   15   4 0.0
  3 WET SCRUBBER LO EFFIC           0.0 80.0    0.126E 01  0.145E 00  0.0        2.00  0.0    0.0   1.0  0.38 0.75 1.50 3.00   15   3 0.0
  4 GRAV COLLECTOR HI EFFIC         0.0 60.0   -0.445E 00  0.326E 00  0.0        1.00  0.0    0.0  .1.0  0.25 0.50 1.00 2.00   15   0 0.0
  5 GRAV COLLECTOR MED EFFIC        0.0 40.0   -0.420E-01  0.155E 00  0.0        1.00  0.0    0.0   1.0  0.25 0.50 1.00 2.00   15   0 0.0
  6 GRAV COLLECTOR LO EFFIC         0.0 30.0    0.300E-02  0.560E-01  0.0        1.00  0.0    0.0   1.0  0.25 0.50 1.00 2.00   15   0 0.0
  7 CYCLONE HI EFFIC                0.0 85.0    0.241E 01  0.197E 00  0.0        1.00  0.0    0.0   1.0  0.25 0.50 1.00 2.00   15   4 0.0
  8 CYCLONE MED EFFIC               0.0 75.0    0.151E 01  0.157E 00  0.0        1.00  0.0    0.0   1.0  0.25 0.50 1.00 2.00   15   3 0.0
  9 CYCLONE LO EFFIC                0.0 60.0    0.244E 00  0.990E-01  0.0        1.00  0.0    0.0   1.0  0.25 0.50 1.00 2.00   15   2 0.0
 10 ELECT PRECIP HI EFFIC           0.0 99.0    0.424E 02  0.623E 00  0.0        1.00  0.0    0.0   1.0  0.50 1.50 3.00 6.00   15   0 0.0
 11 ELECT PRECIP MED EFFIC          0.0 95.0    0.312E 02  0.441E 00  0.0        1.00  0.0    0.0   1.0  0.50 1.50 3.00 6.00   15   0 0.0
 12 ELECT PRECIP LO EFFIC           0.0 90.0    0.197E 02  0.318E 00  0.0        1.00  0.0    0.0   1.0  0.50 1.50 3.00 6.00   15   0 0.0
 13 GAS SCRUBBER                   80.0 80.0    0.317E 01  0.251E 00  0.0        2.00 10.0    0.0   1.0  0.38 0.75 1.50 3.00   15   5 0.0
 14 MIST ELIMINATOR HI VEL          0.0 99.0    0.266E 01  0.325E 00  0.0        1.00  0.0    0.0   0.0  0.25 0.50 1.00 2.00   15  10 0.0
 15 MIST ELIMINATOR LO VEL          0.0 85.0    0.177E 01  0.217E 00  0.0        1.00  0.0    0.0   0.0  0.25 0.50 1.00 2.00   15   5 0.0
 16 FABRIC FILTER HI TEMP           0.0 99.0    0.145E 01  0.838E 00  0.0        1.00  0.0    0.0   1.0  0.50 1.25 2.50 5.00   15   5 0.0
 17 FABRIC FILTER MED TEMP          0.0 95.0    0.348E 01  0.448E 00  0.0        1.00  0.0    0.0   1.0  0.50 1.25 2.50 5.00   15   5 0.0
 18 FABRIC FILTER LO TEMP           0.0 99.0    0.266E 01  0.325E 00  0.0        1.00  0.0    0.0   1.0  0.50 1.25 2.50 5.00   15   5 0.0
 19 CATALYTIC AFTERBURNER           0.0 95.0    0.755E 01  0.151E 01  0.0        1.00  0.0    0.0   0.0  0.25 0.50 1.00 2.00   15   1 0.49
 20 CATALYTIC AB WITH HE            0.0 95.0    0.755E 01  0.151E 01  0.0        2.00  0.0    0.0   0.0  0.25 0.50 1.00 2.00   15   1 0.24
 21 DIRECT FLAME AFTERBURNER        0.0 95.0    0.571E 01  0.117E 01  0.0        1.00  0.0    0.0   0.0  0.13 0.25 0.50 1.00   15   1 1.00
 22 DIRECT FLAME AB WITH HE         0.0 95.0    0.571E 01  0.117E 01  0.0        2.00  0.0    0.0   0.0  0.13 0.25 0.50 1.00   15   1 0.40
 27 ELIMINATE COAL                  0.0  0.0    0.0        0.0        0.0        0.0   0.0    0.0   0.0  0.0  0.0  0.0  0.0     0   0 0.0
 28 ELIMINATE COAL AND R OIL        0.0  0.0    0.0        0.0        0.0        0.0   0.0    0.0   0.0  0.0  0.0  0.0  0.0     0   0 0.0
 29 SWITCH TO GAS                   0.0  0.0    0.0        0.0        0.0        0.0   0.0    0.0   0.0  0.0  0.0  0.0  0.0     0   0 0.0
 30 SULFUR LIMITATION 1             0.0  0.0    0.0        0.0        0.0        0.0   0.0    0.0   0.0  0.0  0.0  0.0  0.0     0   0 0.0
 31 SULFUR LIMITATION 2             0.0  0.0    0.0        0.0        0.0        0.0   0.0    0.0   0.0  0.0  0.0  0.0  0.0     0   0 0.0
 32 SULFUR LIMITATION 3             0.0  0.0    0.0        0.0        0.0        0.0   0.0    0.0   0.0  0.0  0.0  0.0  0.0     0   0 0.0
 39 CATALYTIC OXYDATION            90.0  0.0   -0.124E 02  0.167E 01  0.0        0.0   0.0  -27.6   0.0  0.0  0.0  0.0  0.0    15  41 0.0
 40 ALKALIZED ALUMINA              80.0  0.0    0.0        0.216E-05  0.260E-16  0.0   0.0    0.0   0.0  0.0  0.0  0.0  0.0    15   0 0.0
 41 DRY LIMESTONE INJECTION        50.0  0.0    0.0        0.995E-06 -0.603E-16  0.0   2.0    0.0   0.0  0.0  0.0  0.0  0.0    15   0 0.0
 42 WET LIMESTONE INJECTION        80.0 98.0    0.111E-05  0.481E-16  0.0        0.0   2.0    0.0   0.0. 0.0  0.0  0.0  0.0    15   0 0.0
 43 H2SO4 PLANT-CONTACT            97.5  0.0    0.0        0.800E 00  0.0        0.0   0.0  -27.6   0.0  0.0  0.0  0.0  0.0    20   0 0.0
 44 H2SO4 PLANT-2 CONTACT          99.5  0.0    0.0        0.800E 00  0.0        0.0   0.0  -27.6   0.0  0.0  0.0  0.0  0.0    20   0 0.0
 45 SULFUR PLANT                   95.0  0.0    0.0        0.810E 00  0.0        0.0   0.0  -15.0   0.0  0.0  0.0  0.0  0.0    20   0 0.0
```

Figure 7.5-6. Output Format - Device Data.

```
                        DEVICE APPLICATION CRITERIA FOR NEW SOURCE TYPES
REGION:  CENTRAL CITY                                         DATE:  NOVEMBER 13, 1979

                                   DEVICE IDENTIFICATION NUMBERS

                   1  2  3  4  5  6  7  8  9  10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
SIC     PROC      26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

2119     25        X  X  X  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -
                   -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -
```

Figure 7.5-7. Output Format - Device Application Data.



```
            REGION:  CENTRAL CITY               CONTROL COST DATA                              DATE:  NOVEMBER 13, 1970

SOURCE_ID TYP PJ SO2EMRT_ PRTEMRT_ SO2EF PRTEF __RATCAP__ MX_PROC_RATE SHFT COAL_HEAT_ R_OIL_HEAT D_OIL_HEAT  GAS_HEAT_ UECT PLM

211900125  P   1    0.0       0.100  0.0   0.0    0.0            0.30E 03 3.0   0.0        0.0         0.0         0.0       1.00   0

                 SO2     PRT     STK    EXHAUST                               SO2          PRT       COAL        R OIL       D OIL        GAS
           DEV  EFF(%)  EFF(%)  TMP(K)  VOL(ACFM)  IA_COST($)  OM_COST($)  EFC($/T)     EFC($/T)  UTL(T/D)    UTL(G/D)    UTL(G/D)    UTL(CF/D)  FLG
             0    0.0     0.0    338       2000           0           0          0            0          0           0           0            0  0
             1    0.0    98.0    298       1762       15429       14222          0          431          0           0           0            0  0
             2    0.0    70.0    298       1762       11368       10161          0          346          0           0           0            0  0
             3    0.0    80.0    298       1762       10668       10109          0          365          0           0           0            0  0

SOURCE_ID TYP PJ SO2EMRT_ PRTEMRT_ SO2EF PRTEF __RATCAP__ MX_PROC_RATE SHFT COAL_HEAT_ R_OIL_HEAT D_OIL_HEAT  GAS_HEAT_ UECT PLM

280004110  8   2   25.000     4.000  0.0  82.5  0.57E 09        0.0        3.0   0.28E 08  0.0         0.0         0.0       1.00   0

                 SO2     PRT     STK    EXHAUST                               SO2          PRT       COAL        R OIL       D OIL        GAS
           DEV  EFF(%)  EFF(%)  TMP(K)  VOL(ACFM)  IA_COST($)  OM_COST($)  EFC($/T)     EFC($/T)  UTL(T/D)    UTL(G/D)    UTL(G/D)    UTL(CF/D)  FLG
             0    0.0     0.0    483     194000           0           0          0            0        385           0           0            0  0
             7    0.0    52.0    483     193999       44948       35162          0           59        385           0           0            0  0
            10    0.0    98.4    483     193999       92082       52759          0           64        385           0           0            0  0
            11    0.0    92.0    483     193999       78620       50490          0           58        385           0           0            0  0
            12    0.0    84.0    483     193999       68071       48470          0           55        385           0           0            0  0
            16    0.0    99.0    483     193999      100377       60874          0           69        385           0           0            0  0
            27   19.4    96.2    483     193999      577965      577965        326          411          0       71745           0            0  0
            28   48.6    97.3    483     193999     1596251     1596251        360         1123          0           0
            29   99.9    99.5    483     193999     1171840     1171840        128          806          0
            30   20.5    -3.7    483     193999      187366      187366        100            0        390
            31   55.1    -3.7    483     193999      333095      333095         66            0
            32   77.5     3.4    483     193999      497167      497167         70

SOURCE_ID TYP PJ SO2EMRT_ PRTEMRT_ SO2EF PRTEF __RATCAP__ MX_PROC_RATE

281903302  P   2   19.100     0.260  0.0  93.7    0.0

                 SO2     PRT     STK    EXHAUST
           DEV  EFF(%)  EFF(%)  TMP(K)  VOL(ACFM)  IA_C
             0    0.0     0.0    361      86100
            13   80.0    20.0    300
            14    0.0    99.0    361
            15    0.0    85.0    361

SOURCE_ID TYP PJ SO2EMRT_

281903402  P
```

Figure 7.5-8. Output Format - Control Cost Data.

7.6 CONTROL COST FILE UPDATE PROGRAM

7.6.1 Description

The Control Cost File Update Program is a FORTRAN program designed to alter existing records on the Control Cost File. The program will not add or delete records from this file.

Input to the program consists of the file to be altered (magnetic tape or disk) and punched cards describing the data elements within each record, to be changed.

7.6.2 JCL and Deck Setup

The deck configuration and JCL cards used for the installation test case are illustrated in Figures 7.6-1 and 7.6-2. This setup assumes use of the program object deck and a Control Cost File on magnetic tape. If other configurations are used, modifications to the JCL cards are required.

7.6.3 Input

The construction of the input data set is accomplished through input of the appropriate NAMELIST punched card data shown in Table 7.6-1. The variables listed in this table define a complete source-device record. For each Control Cost File record to be changed, the user must input data for the following variables:

(a) The first six NAMELIST variables must be input to define the record being changed.

(b) The new values of the variables to be changed (PRTYPE thru PLUME) must be input (no special order of the input variables is required).

(c) The &END variable must be input last to indicate the end of the NAMELIST data for that record.

This data (items a, b, and c) must be contained on no move than three punched cards (a restriction of the program update procedure). The collection of record changes defines the data set in ascending order by source identification (ISIC, ISIT, IPROC), and for each source in ascending order by device number (IDDEV). The user should note that if extensive changes (i.e., more data than can be contained on three cards) to a given record are desired, several update runs will be required. An example data form with prepared inputs is shown in Figure 7.6-3

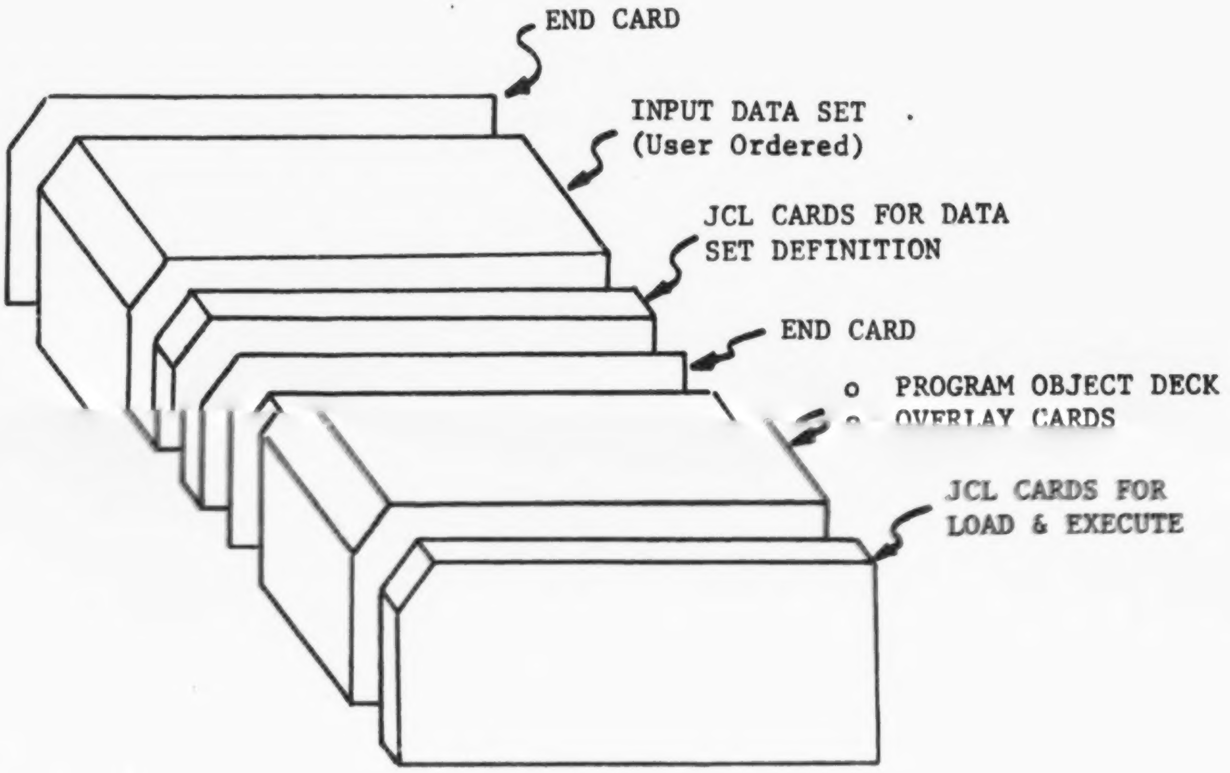

END CARD
INPUT DATA SET
(User Ordered)
JCL CARDS FOR DATA
SET DEFINITION
END CARD
o PROGRAM OBJECT DECK
o OVERLAY CARDS
JCL CARDS FOR
LOAD & EXECUTE

Figure 7.6-1. Example Deck Configuration for the Control Cost File Update Program.

```
                              COST MODEL UPDATE

LOAD AND        //COST  EXEC FORTGLG
EXECUTE         //LKED.SYSIN  DD *

PROGRAM DECK                       OBJECT DECK

END CARD        /*
                //GO.FT13F001  DD DSN=CCSTD,UNIT=2400,DISP=(OLD,KEEP),
                //               VOL=SER=C00123,
                //               DCB=(RECFM=VBS,LRECL=136,BLKSIZE=140)
DATA SET        //GO.FT14F001  DD DSN=CCSTD,UNIT=2400,
DEFINITION      //               DISP=(OLD,KEEP),
                //               VOL=SER=C00358,
                //               DCB=(RECFM=VBS,LRECL=136,BLKSIZE=140)
                //GO.FT12F001  DD  UNIT=SYSDA,SPACE=(CYL,(50),,CONTIG)
                //GO.SYSIN  DD *

DATA SET                           NAMELIST DATA

END CARD        /*
```

Figure 7.6-2. Example JCL Card Setup for the Control Cost File Update Program.

TABLE 7.6-1

PUNCHED CARD INPUT FOR THE CONTROL COST FILE UPDATE PROGRAM

Card Type	Picture*	Description
NM	--	&STRATM - A NAMELIST variable indicating the start of NAMELIST inputs for a given record in the Control Cost File. No equals sign or values are associated with this variable.
MNI	XXX	IREGR - Region identification code.
MNI	XXXX	ISIC - SIC code.
MNI	XXX	ISIT - Site number.
MNI	XX	IPRC - Process code.
MMI	XX	IDDEV - Device number.

The above variables, and &END, are required for each record change. Of the following variables, only those being changed need be input.

Card Type	Picture*	Description
ONA	A	PRTYPE - Process type (B, P, or S).
ONI	XX	POLJUR - Political Jurisdiction.
ONP	X.XXX	DEVEFS - Existing device efficiency for SO_2 removal (decimal fraction).
ONP	X.XXXX	DEVEFP - Existing device efficiency for Particulate removal (decimal fraction).
ONP	XXXXX.XXX	EMRATS - Existing SO_2 emission rate (tons/day).
ONP	XXXXX.XXX	EMRATP - Existing Particulate emission rate (tons/day).
ONP	XX.X	SHIFTS - Number of shifts per day.
ONP	XXXXXXXX.	PRCRTM - Maximum process rate (lb/hr).

---

*Indicates the maximum dimension allowed.

TABLE 7.6-1

PUNCHED CARD INPUT FOR THE CONTROL COST FILE UPDATE PROGRAM (Continued)

Card Type	Picture*	Description
ONP	XXXXX.XXX	STKHTN - Stack height (meters).
ONP	XXX.XXXXX	STKDIA - Stack diameter, (meters).
ONP	XXXX.XXXX	EXVELN - Stack exit velocity (meters/second).
ONP	XXXXX.XXX	TEXN - Stack exit temperature, after control (degrees Kelvin).
ONP	XXXXXXX.XXXXX	RATCAP - Rated capacity (BTU/hr).
ONP	X.XXX	CONEFS - New device efficiency for SO_2 (decimal fraction).
ONP	X.XXXX	CONEFP - New device efficiency for Particulates (decimal fraction).
ONP	XXXXXXXX.	ACFMN - Exhaust gas volume after control (ACFM).
ONP	XXXXXXXXXX.	TAC - Total annual cost ($/year).
ONP	XXXXXXX.XXX	HEC - Coal heat output, after control (BTU/year).
ONP	XXXXXXX.XXXX	HER - Residual oil heat output, after control (BTU/year).
ONP	XXXXXXX.XXX	HED - Distillate oil heat output, after control (BTU/year).
ONP	XXXXXXXXXX.	HEG - Gas heat output, after control (BTU/year).
ONP	XXXXXX.	AMC - Coal Burned, after control (tons/day).
ONP	XXXXXXX.	AMR - Residual oil burned, after control (gal/day).
ONP	XXXXXXX.	AMD - Distillate oil burned, after control (gal/day).

---

*Indicates the maximum dimension allowed.

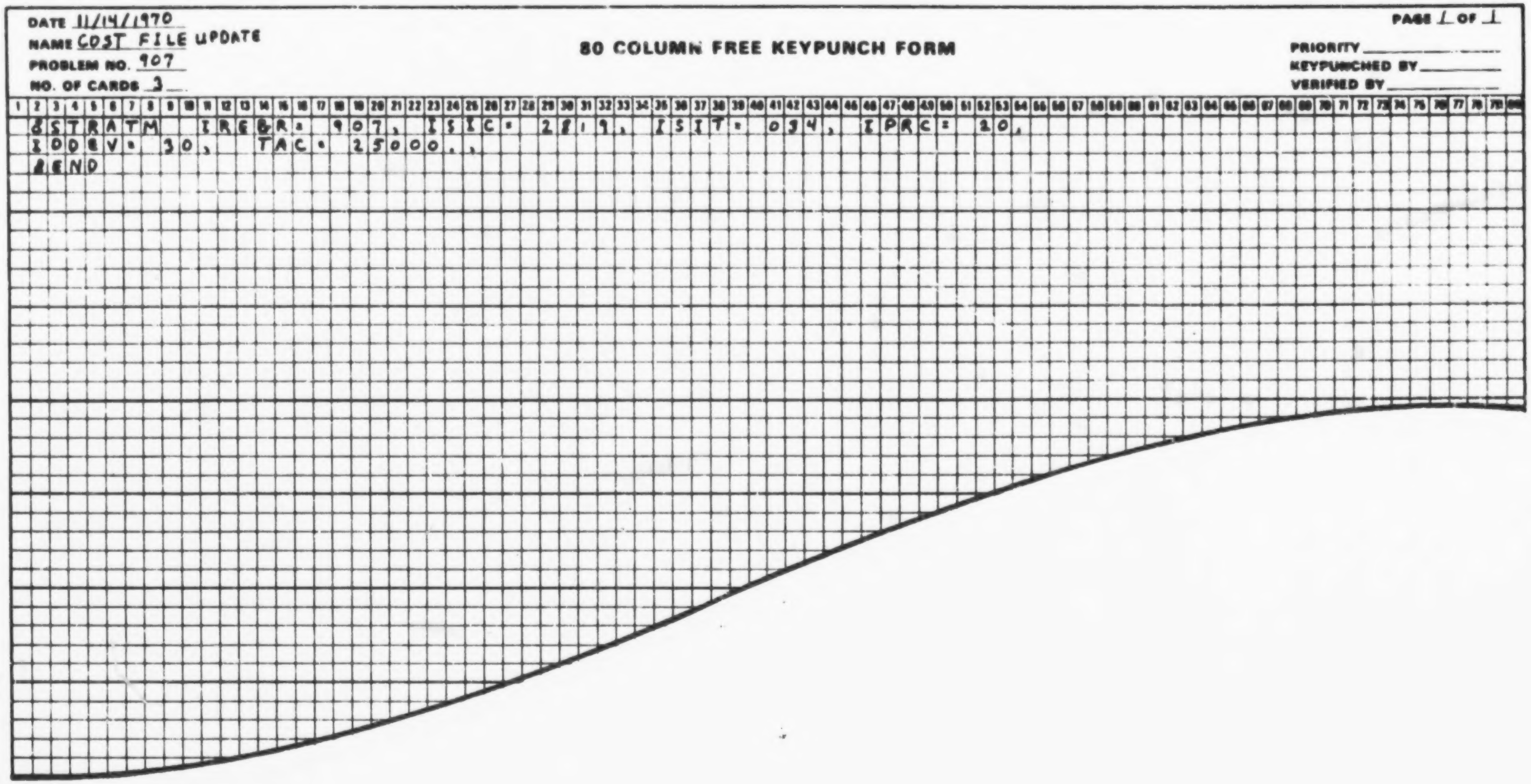
TABLE 7.6-1

PUNCHED CARD INPUT FOR THE CONTROL COST
FILE UPDATE PROGRAM (Continued)

Card Type	Picture*	Description
ONP	XXXXXXXXX.	AMG - Gas burned, after control (ft^3/day).
ONP	XX.XX	ØUSE - Use factor (decimal fraction).
ONP	XXXXXX.XXX	AEMIS - Allowable emission rate (tons/day).
ONI	X	IGAS - Gas cooling flag (1=yes, 0=no).
ONP	XXXXX.X	PLUME - Normalized plume rise (square meters/second).
MN	--	&END - This variable signifies the end of the list of NAMELIST cards defining a given record.

---

[*] Indicates the maximum dimension allowed.



DATE 11/14/1970
NAME COST FILE UPDATE
PROBLEM NO. 907
NO. OF CARDS 3

80 COLUMN FREE KEYPUNCH FORM

PAGE 1 OF 1
PRIORITY ____
KEYPUNCHED BY ____
VERIFIED BY ____

```
 &STRATM  IREGR= 907, ISIC= 2819, ISIT= 034, IPRC= 20,
 IDDEV= 30,  TAC= 25000.,
 &END
```

Figure 7.6-3. Example Input Data Form for the Control Cost File Update Program.

7.6.4 Output

After the cost file update operation is completed, the program produces a NAMELIST dump of the updated file contents as illustrated in Figure 7.6-4. If the source identification is incorrect or the record change sets are out of order, the update operation will terminate with an error message indicating the problem.

```
              &STRATM
              IREGR=907,ISIC=2819,ISIT=034,IPRC=20,IDDEV=30,TAC=25000.,
              &END
&STRATM
IREGR=        907,ISIC=       2119,ISIT=          1,IPRC=         25,IDDEV=          0,PRTYPE=-0.12427946E 28,POLJUR=         1,
DEVEFS= 0.0          ,DEVEFP= 0.0            ,EMRATS= 0.0             ,EMRATP= 0.99999964E-01,PRCRTM=  300.00000    ,SHIFTS=
  3.0000000   ,STKHTN=  15.240000    ,STKDIA= 0.60959995    ,EXVELN=  15.240000    ,TEXN=  338.59985    ,RATCAP= 0.0        ,
CONEFS= 0.0          ,CONEFP= 0.0            ,ACFMN=  2000.0000    ,TAC= 0.0            ,HEC= 0.0            ,HER= 0.0        ,
HED= 0.0        ,HEG= 0.0         ,AMC= 0.0            ,AMR= 0.0            ,AMD= 0.0          ,AMG= 0.0          ,OUSE=
  1.0000000   ,AEMIS= 0.0            ,IGAS=          0,PLUME= 0.0           ,IUSE=           1
&END
&STRATM
IREGR=        907,ISIC=       2119,ISIT=          1,IPRC=         25,IDDEV=          1,PRTYPE=-0.12427946E 28,POLJUR=         1,
DEVEFS= 0.0          ,DEVEFP= 0.97999966    ,EMRATS= 0.0             ,EMRATP= 0.99999964E-01,PRCRTM=  300.00000    ,SHIFTS=
  3.0000000   ,STKHTN=  15.240000    ,STKDIA= 0.57219911    ,EXVELN=  15.240000    ,TEXN=  298.32617    ,RATCAP= 0.0        ,
CONEFS= 0.0          ,CONEFP= 0.0            ,ACFMN=  1762.1162    ,TAC=  15429.367    ,HEC= 0.0            ,HER= 0.0        ,
HED= 0.0        ,HEG= 0.0         ,AMC= 0.0            ,AMR= 0.0            ,AMD= 0.0          ,AMG= 0.0          ,OUSE=
  1.0000000   ,AEMIS= 0.0            ,IGAS=          0,PLUME= 0.0           ,IUSE=           1
&END
&STRATM
IREGR=        907,ISIC=       2119,ISIT=          1,IPRC=         25,IDDEV=          2,PRTYPE=-0.12427946E 28,POLJUR=         1,
DEVEFS= 0.0          ,DEVEFP= 0.89999968    ,EMRATS= 0.0             ,EMRATP= 0.99929964E-01,PRCRTM=  300.00000    ,SHIFTS=
  3.0000000   ,STKHTN=  15.240000    ,STKDIA= 0.57219911    ,EXVELN=  15.240000    ,TEXN=  298.32617    ,RATCAP= 0.0        ,
CONEFS= 0.0          ,CONEFP= 0.0            ,ACFMN=  1762.1162    ,TAC=  11368.902    ,HEC= 0.0            ,HER= 0.0        ,
HED= 0.0        ,HEG= 0.0         ,AMC= 0.0            ,AMR= 0.0            ,AMD= 0.0          ,AMG= 0.0          ,OUSE=
  1.0000000   ,AEMIS= 0.0            ,IGAS=          0,PLUME= 0.0           ,IUSE=           1
&END
&STRATM
IREGR=        907,ISIC=       2119,ISIT=          1,IPRC=         25,IDDEV=          3,PRTYPE=-0.12427946E 28,POLJUR=         1,
DEVEFS= 0.0          ,DEVEFP= 0.79959965    ,EMRATS= 0.0             ,EMRATP= 0.99999964E-01,PRCRTM=  300.00000    ,SHIFTS=
  3.0000000   ,STKHTN=  15.240000    ,STKDIA= 0.57219911    ,EXVELN=  15.240000    ,TEXN=  298.32617                        ,
CONEFS= 0.0          ,CONEFP= 0.0            ,ACFMN=  1762.1162    ,TAC=  10668.500    ,HEC= 0.0
HED= 0.0        ,HEG= 0.0         ,AMC= 0.0            ,AMR= 0.0            ,AMD= 0.0
  1.0000000   ,AEMIS= 0.0            ,IGAS=          0,PLUME= 0.0           ,IUSE=
&END
&STRATM
IREGR=        907,ISIC=       2800,ISIT=         41,IPRC=         10,
DEVEFS= 0.0          ,DEVEFP= 0.0            ,EMRATS=  25.000000
  3.0000000   ,STKHTN=  24.078995    ,STKDIA=  2.5603199
CONEFS= 0.0          ,CONEFP= 0.82499981    ,ACFMN=  194000.0
HED= 0.0        ,HEG= 0.0         ,AMC=  385.00000
  1.0000000   ,AEMIS= 0.0            ,IGAS=          0,
&END
&STRATM
IREGR=        907,ISIC=       2800,ISIT=
DEVEFS= 0.0          ,DEVEFP= 0.51999921
  3.0000000   ,STKHTN=  24.078995
CONEFS= 0.0          ,CONEFP= 0.
HED= 0.0        ,HEG= 0.0
  1.0000000   ,AEMIS= 0
&END
&STRATM
```

Figure 7.6-4. Output Format for the Control Cost File Update Program.

7.7 EMISSION STANDARDS PROGRAM

7.7.1 Description

The Emission Standards Program utilizes input data from the Control Cost File and from punched card input. The Control Cost File data is listed in Table 7.6-1. The punched card input is described in this section.

The function of this program is to create an output file (Emission Standards File) containing those controlled sources which conform to specified emission standards. The file may then be used by the Regional Strategies Program. The fundamental sequence of events for operation of the Emission Standards Program is as follows:

(a) Call sort routine to order contents of the Control Cost File by;

Political jurisdiction - source category - source identification - device number.

(b) Input punched card data in the order; all data for political jurisdiction 1, all data for political jurisdiction 2, etc.

(c) The program reads in all punched card data for political jurisdiction 1, then;

 (1) Read in all device application records for first source on sorted Control Cost File.

 (2) For each input standard which corresponds to the source category number, select the least expensive control device which satisfies the standard.

 (3) Repeat 1 and 2 for the second, third, etc., sources until all sources in the political jurisdiction have been considered.

(d) Output results to print routine and the Emission Standards File.

(e) The program then reads in the data for political jurisdiction 2, 3, ..., etc, repeating step (c) each time.

7.7.2 JCL and Deck Setup

Figure 7.7-1 illustrates an example deck setup for the execution of the Emission Standards Program. Figure 7.7-2 illustrates the specific JCL cards used for the execution of the test case. The general categories illustrated in these figures are as follows:

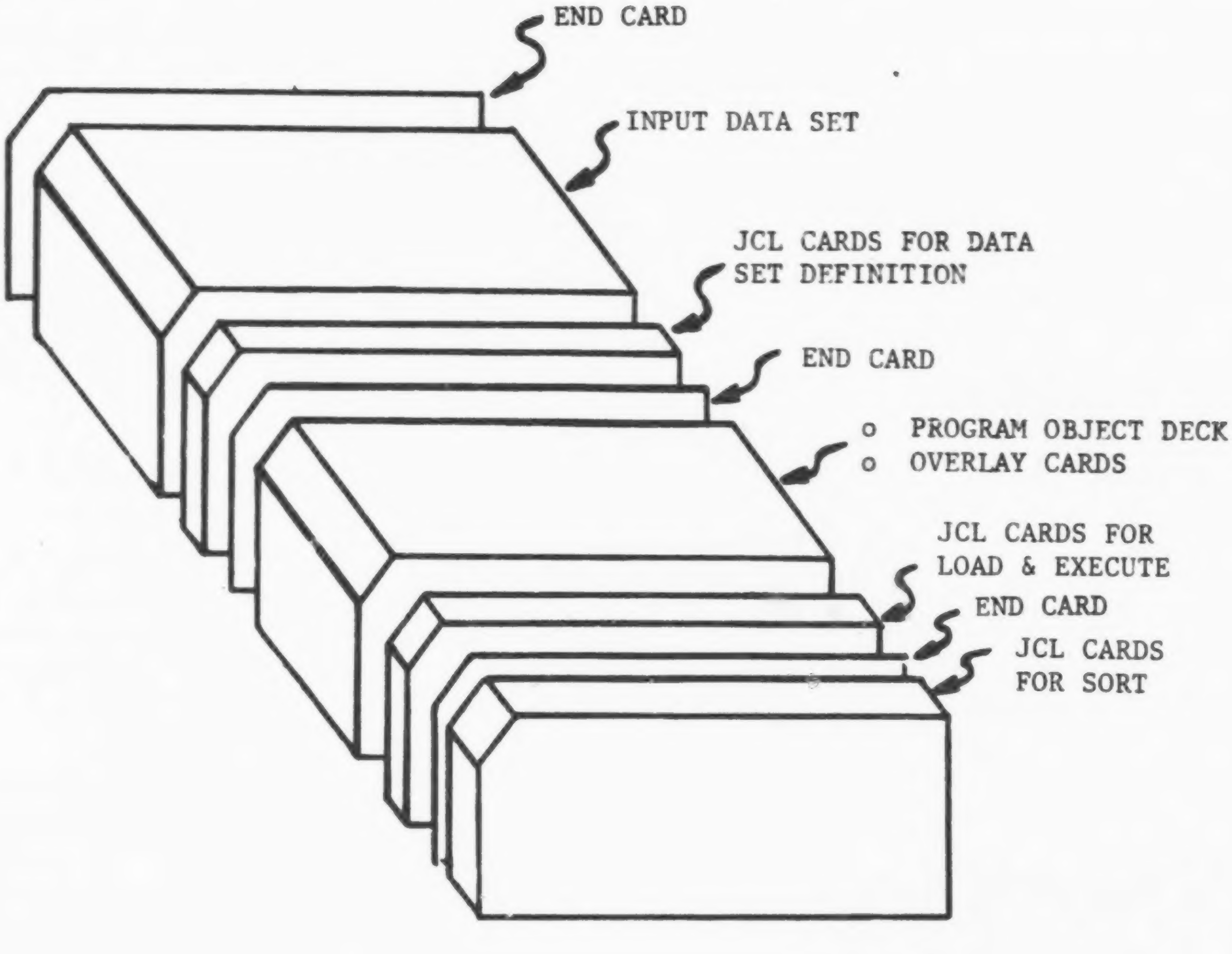

END CARD
INPUT DATA SET
JCL CARDS FOR DATA SET DEFINITION
END CARD
o PROGRAM OBJECT DECK
o OVERLAY CARDS
JCL CARDS FOR LOAD & EXECUTE
END CARD
JCL CARDS FOR SORT

Figure 7.7-1. Example Deck Configuration for the Emission Standards Program.

```
                                         ESTAND DECK SETUP

                 //CCFSORT  EXEC  SORTD
                 //SORTIN   DD  DSN=COSTO,UNIT=2400,LABEL=(,SL,,IN),VOL=SER=000425,
                 //   DISP=(OLD,KEEP),DCB=(RECFM=VBS,LRECL=136,BLKSIZE=1364)
                 //SORT.SORTWK01 DD UNIT=SYSDA,SPACE=(CYL,10,,CONTIG)
                 //SORT.SORTWK02 DD UNIT=SYSDA,SPACE=(CYL,10,,CONTIG)
SORT             //SORT.SORTWK03 DD UNIT=SYSDA,SPACE=(CYL,10,,CONTIG)
                 //SORT.SORTWK04 DD UNIT=SYSDA,SPACE=(CYL,10,,CONTIG)
                 //SORT.SORTOUT  DD DSN=&CCFILE,UNIT=SYSDA,DISP=(NEW,PASS),
                 //    SPACE=(CYL,(5,1)),DCB=(RECFM=VBS,LRECL=136,BLKSIZE=1364)
                 //SORT.SYSIN  DD  *
                  SORT FIELDS=(29.0,4.0,A,25.0,1.0,A,9.0,12.0,A,21.0,4.0,A),FORMAT=BI
END CARD         /*
LOAD AND         //LG      EXEC  PROC=FORTGLG,PARM.LKED=(MAP,OVLY,XREF)
EXECUTE          //LKED.SYSIN      DD  *

                 **********       OBJECT DECK HERE                                    **********

                  OVERLAY A
                  INSERT PRESET,INLIST
PROGRAM DECK      INSERT ERROUT,OPLIST
AND OVERLAY       OVERLAY A
CARDS             INSERT EST01,EST02,EST03,EST04,EST05,EST06,EST07,EST08,EST09,EST10
                  INSERT EST11,EST12,EST13,EST14,EST15,EST16,EST17,EST18,EST19,EST20
                  INSERT EST21,EST22,EST23,EST24,EST25,EST26
END CARD         /*
                 //GO.FT08F001  DD  DSN=&ERRMSG,UNIT=SYSDA,
                 //               DCB=(RECFM=FB,LRECL=133,BLKSIZE=2660),SPACE=(TRK,(1,1)),
DATA SET         //               DISP=(NEW,PASS)
DEFINITION       //GO.FT09F001 DD DSN=&CCFILE,UNIT=SYSDA,DISP=(OLD,PASS)
                 //GO.FT20F001 DD DSN=ESFILE,UNIT=2400,LABEL=(,SL,,OUT),DISP=(NEW,KEEP),
                 //    DCB=(RECFM=VBS,LRECL=80,BLKSIZE=1604)
                 //GO.SYSABEND DD SYSOUT=A
                 //GO.SYSIN  DD  *

DATA SET         **********       ESTAND DATA HERE                                    **********

END CARD         /*
```

Figure 7.7-2. Example JCL Card Setup for the Emission Standards Program.

(a) JCL cards for sort - these cards specify that the Control Cost File is sorted as follows: order sources by political jurisdiction number (1, 2, ...10); within each political jurisdiction set, order sources by source category number (1,2,3); within each category, order sources by identification number (SIC, Site, process number); within each source group order by device.

(b) JCL cards for load and execution of the Emission Standards Program - the cards illustrated in Figure 7.7-2 are for utilization of the program object deck. If the program is on disk or in source deck form, these JCL cards must be modified.

(c) Program object deck.

(d) JCL cards for Data Set definition.

(e) Card Input data set.

7.7.3 Input

The card input Data Set (Figure 7.7-3) consists of a region card followed by data groups for each of the political jurisdictions defined for the region. Each data group consists of an &ESTAND card which contains the political jurisdiction number and name (for which the data is to be applied), data cards specifying the emission standard information to be applied, and an &END card which indicates the end of the data group. The data groups must be input by order of ascending political jurisdiction numbers (1, 2, 3, ..., etc.). Further, all political jurisdictions must be represented by an &ESTAND and &END set of cards (containing the political jurisdiction number and name). Thus, for example, if no emission standards data are to be applied to political jurisdiction 2, no cards would be included between the &ESTAND NPJ = 2, NAMEPJ = JURISDICTION 2 and &END cards.

A detailed description of the input data cards is given in Table 7.7-1. There are 26 emission standard types which may be included in the different political jurisdiction data groups. Within each political jurisdiction, data for each emission standard may be specified for any or all of the pollutant - source category combinations indicated.

To construct a data group from the input variables listed in Table 7.7-1, the following items must be considered.

- The first card must be the region card.

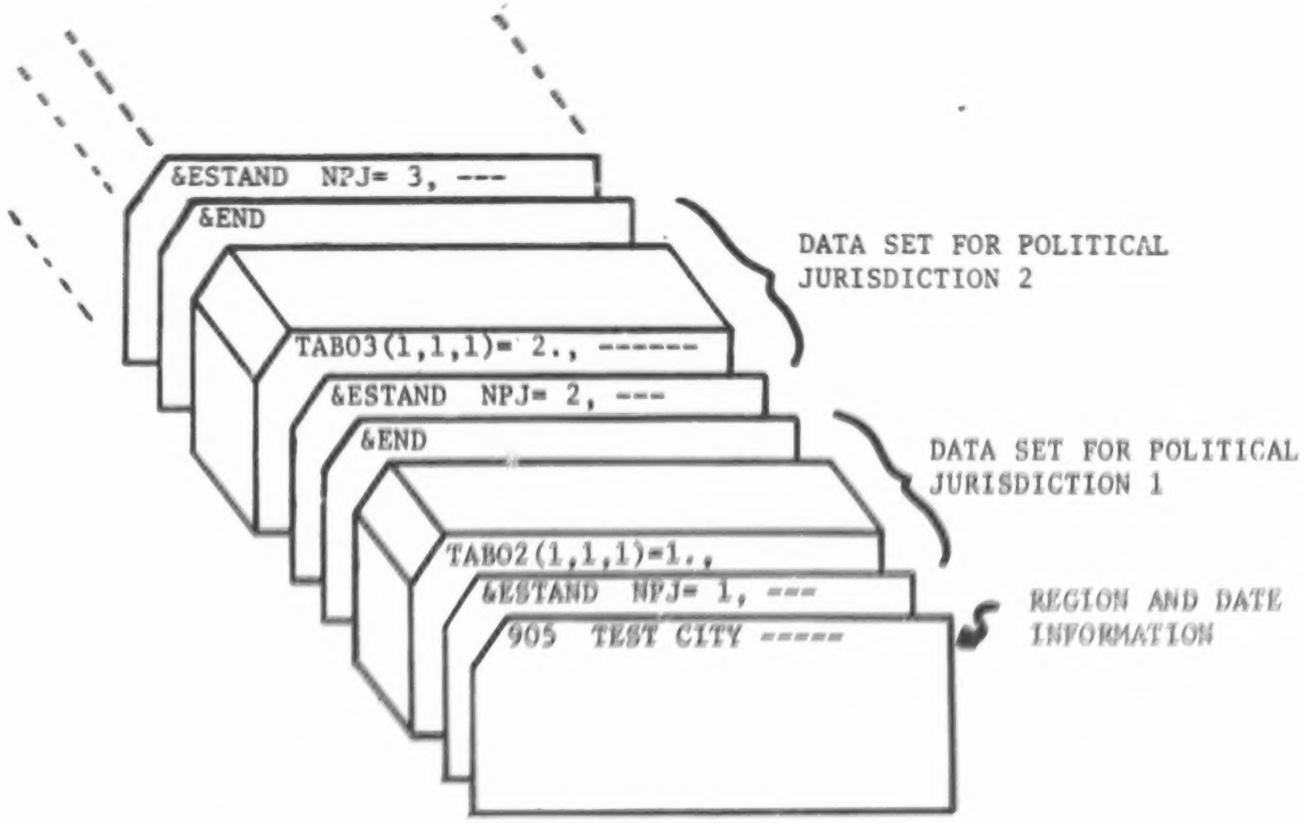

&ESTAND NPJ= 3, ---
&END
TAB03(1,1,1)= 2., ------
&ESTAND NPJ= 2, ---
&END
TAB02(1,1,1)=1.,
&ESTAND NPJ= 1, ---
905 TEST CITY -----
DATA SET FOR POLITICAL JURISDICTION 2
DATA SET FOR POLITICAL JURISDICTION 1
REGION AND DATE INFORMATION

Figure 7.7-3. Example Input Data Set Configuration for the Emission Standards Program.

TABLE 7.7-1

PUNCHED CARD INPUT FOR THE EMISSION STANDARDS PROGRAM

Data Type		Description	
MF		Region Card	
	Column	Card Data	Format
	1-3	• Region number, obtained from list in Appendix B.	Right Adjusted
	4-23	• Region name and/or run description.	--
	24-43	• Date.	--
MN		&ESTAND - a NAMELIST variable indicating start of a list of NAMELIST inputs for a particular political jurisdiction. No equals sign or values are associated with this variable.	
MNI		NPJ - number of the political jurisdiction for which this set of data is being input.	
ONA		NAMEPJ - up to 72 characters (preceded by an apostrophe and followed by an apostrophe and comma) identifying the political jurisdiction for which this set of data is being input.	
ONP		TAB01(1,P,C) - flag for application of the Null Standard. Set to 1. if standard is to be applied. TAB01(1,P,C) flag must be set for each desired combination of P = 1 or 2 and C = 1 or 2 or 3.	
ONP		TAB02(1,P,C) - flag for application of the Maximum Technology Standard. Set to 1. if standard is to be applied. TAB02(1,P,C) flags must be set for each desired combination of P = 1 or 2 and C = 1 or 2 or 3.	
ONI		NOBN02 - set to 1 to eliminate open burning during application of TAB02(1,2,3).	
ONP		TAB03(1,P,C) - data for Maximum Technology (with Devices Excluded) Standard; Flag plus one to ten device numbers. If no devices are to be excluded, set flag to 1.. If from one to ten devices are to be excluded, set flag tc 2. and input device identification	

TABLE 7.7-1

PUNCHED CARD INPUT FOR THE EMISSION STANDARDS PROGRAM (Continued)

Data Type	Description
	of excluded devices. TAB03(1,P,C) data must be input for each desired combination of P = 1 or 2 and C = 1 or 2 or 3.
ONI	NØBN03 - set to 1 to eliminate open burning during application of TAB03(1,2,3).
ONP	TAB04(1,P,C) - same operation as TAB03(1,P,C) data.
ONI	NØBN04 - set to 1 to eliminate open burning during application of TAB04(1,2,3).
ONP	TAB05(1,P,C) - data for Potential Emission Standard; flag plus 5 pairs of curve coordinates. If pre-set curve is desired, set flag to 1. and omit curve data. If new data is desired, set flag to 2. and input 5 pairs of Potential Emission (lb/hr) vs Allowable Emission (lb/hr) points. TAB05(1,P,C) data must be input for each desired combination of P = 1 or 2 and C = 2 or 3.
ONI	NØBN05 - set to 1 to eliminate open burning during application of TAB05(1,2,3).
ONP	TAB06(1,P,C) - same operation as TAB05(1,P,C).
ONI	NØBN06 - set to 1 to eliminate open burning during application of TAB06(1,2,3).
ONP	TAB07(1,P,C) - same operation as TAB05(1,P,C).
ONI	NØBN07 - set to 1 to eliminate open burning during application of TAB07(1,2,3).
ONP	TAB08(1,P,C) - data for Heat Input Standard: flag plus four pairs of curve coordinates. If pre-set curve is desired, input flag value as 1. and omit curve coordinates. If input curve is desired, input flag value as 2. and four pairs of Heat Input (10^6 BTU) vs Allowable Emission (lb/10^6 BTU/hr) points. TAB08(1,P,C) data must be input for each desired combination of P = 1 or 2 and C = 1.

TABLE 7.7-1

PUNCHED CARD INPUT FOR THE EMISSION STANDARDS PROGRAM (Continued)

Data Type	Description
ONP	TAB09(1,P,C) - same operation as TAB08.
ONP	TAB10(1,P,C) - same operation as TAB08.
ONP	TAB11(1,P,C) - data for Heat Input (with physical stack height parameters) standard; flag plus seven sets of curve data. If pre-set curves are desired, input flag value as 1. and no curve data. If input curves are desired, input flag as 2. and seven sets of curve data. Each set of curve data consists of the physical stack height (ft) for which the curve applies and three pairs of Heat Input (10^6 BTU) vs Allowable Emission (lb/10^6 BTU/hr) points. TAB11 (1,P,C) data must be input for each desired combination of P = 1 or 2 and C = 1.
ONP	TAB12(1,P,C) - data for Effective Standard; flag plus Ambient Temperature (deg F), Ambient Pressure (mb), Average Wind Speed (ft/sec) plus 12 pairs of curve coordinates. If pre-set data is desired, input flag value as 1. and omit pressure, wind speed and curve data. If input data is desired, input flag value as 2. and input ambient conditions and twelve pairs of Effective Stack Height (ft) vs Allowable Emission (lb/hr) points. TAB12(1,P,C) data must be input for each desired combination of P = 1 or 2 and C = 1 or 2 or 3.
ONI	NØBN12 - set to 1 to eliminate open burning during application of TAB12(1,2,3).
ONP	TAB13(1,P,C) - data for Exhaust Concentration (ppm) Standard; flag plus Exhaust Concentration (ppm) value. If pre-set value is desired, input flag value as 1. and omit exhaust concentration value. If new input is desired, input flag as 2. and new exhaust concentration value. TAB13(1,P,C) data must be input for each desired combination of P = 1 and C = 1 or 2 or 3.
ONP	TAB14(1,P,C) - same operation as TAB13.

TABLE 7.7-1

PUNCHED CARD INPUT FOR THE EMISSION STANDARDS PROGRAM (Continued)

Data Type	Description
ONP	TAB15(1,P,C) - data for Exhaust Concentration Standard (double value gr/SCF); flag plus curve values. If pre-set values are desired input flag value as 1. and no curve data. If new data is desired input flag as 2. and grain loading limit 1 (gr/SCF), switch value of process weight (lb/hr), grain loading limit 2 (gr/SCF). TAB15(1,P,C) data must be input for each desired combination of P = 2 and C = 2 or 3.
ONI	NØBN15 - set to 1 to eliminate open burning during application of TAB15(1,2,3).
ONP	TAB16(1,P,C) - data for Exhaust Concentration Standard (gr/SCF); flag plus grain loading limit. If pre-set value is desired set flag to 1. and omit grain loading value. If new value is desired, set flag to 2. and input grain loading value (gr/SCF). TAB16 (1,P,C) data must be input for each desired combination of P = 2 and C = 1 or 2 or 3.
ONI	NØBN16 - set to 1 to eliminate open burning during application of TAB16(1,2,3).
ONP	TAB17(1,P,C) - data for Exhaust Concentration Standard (lb/1000lb); flag plus exhaust concentration limit. If pre-set value is desired input flag value as 1. and omit concentration value. If new value is desired, input flag as 2. and input exhaust concentration value (lb/1000 lb). TAB17(1,P,C) data must be input for each desired combination of P = 2, C = 1 or 2 or 3.
ONI	NØBN17 - set to 1 to eliminate open burning during application of TAB17(1,2,3).
ONP	TAB18(1,P,C) - data for Process Weight Standard; flag plus eleven pairs of curve coordinates. If pre-set curve is desired input flag value of 1. and omit curve data. If new curve data is desired input flag as 2. and eleven pairs of Process Weight (lb/hr) vs Allowable Emission (lb/hr) points.

TABLE 7.7-1

PUNCHED CARD INPUT FOR THE EMISSION STANDARDS PROGRAM (Continued)

Data Type	Description
	TAB18(1,P,C) data must be input for each desired combination of P = 1 or 2 and C = 2 or 3.
ONI	NØBN18 - set to 1 to eliminate open burning during application of TAB18(1,2,3).
ONP	TAB19(1,P,C) - same operation as TAB18.
ONI	NØBN19 - set to 1 to eliminate open burning during application of TAB19(1,2,3).
ONP	TAB20(1,P,C) - same operation as TAB18.
ONI	NØBN20 - set to 1 to eliminate open burning during application of TAB20(1,2,3).
ONP	TAB21(1,2,1) - data for Fuel Switch Standard; flag value. Set flag to; 1. to eliminate coal, 2. to eliminate coal and residual oil, 3. to eliminate coal, residual oil and distillate oil.
ONP	TAB22(1,2,1) - same operation as TAB21.
ONP	TAB23(1,1,1) - data for Sulfur Limitation Standard; flag. Set flag to 1. for application of Control Device 30.
ONP	TAB24(1,1,1) - data for Sulfur Limitation Standard; flag. Set flag to 1. for application of Control Device 31.
ONP	TAB25(1,1,1) - data for Sulfur Limitation Standard; flag. Set flag to 1. for application of Control Device 32.
ONP	TAB26(1,1,1) - Flue Gas Desulfurization Standard; flag, plus number. Number indicates Fuel Sulfur limits as follows; 1. use limits specified for Control Device 30, 2. use limits specified for Control Device 31, 3. use limits specified for Control Device 32.
MN	&END - this variable indicates the end of a list of NAMELIST inputs.

- A data group for each political jurisdiction, in the order NPJ = 1, NPJ = 2, ..., etc., must follow the first card. All political jurisdictions must be represented.
- Within each data group defined by the beginning card &ESTAND NPJ = XX,NAMEPJ = XXXXX... and final card &END, data for each of the desired emission standard types must be specified.
- Data for each emission standard type is input through use of the NAMELIST variable;

  TABXX(1,P,C) = Flag, X_1, X_2, ...

  where

  XX = Emission Standard Type, EST01 through EST26 as described in Chapter 6.

  P = pollutant type: 1 = SO_2, 2 = particulates.

  C = Source Category: 1 = fuel combustion, 2 = industrial process, 3 = solid waste.

  Flag = Floating point indicator for pre-set or input data; set to 1. to indicate pre-set data is used (therefore, no data: X_1, X_2... will be input), 2. indicates input data is to be used, therefore the input data: X_1, X_2... must be included. The pre-set data for each standard is given in Table 7.7-2 (SO_2) and Table 7.7-3 (particulates).
- If no TABXX(1,P,C) = Flag, entry is made, the associated standard will not be applied, i.e., only those standards specified as either input or pre-set will be applied.
- The pollutant and source category ranges for which the standard is applicable are specified in its description (see also Table 7.7-2).
- If the standard is applied to solid waste-particulate control and open burning is to be eliminated, the flag NØBNXX = 1 must be input.
- An example data form is shown in Figure 7.7-4.
- All emission standard curves are log - log (base 10). All curve data must be input in pairs (independent variable, allowable emission) in ascending order by independent variable.

TABLE 7.7-2

PRESET PARAMETERS IN EACH EMISSION STANDARD (SULFUR OXIDE CONTROL STANDARDS)

Variable	Preset Parameters				
TAB01(1,1,C)=1.,					
Fuel Combustion(C=1)	No variables required				
Industrial Process(C=2)	No variables required				
Solid Waste(C=3)	No variables required				
TAB02(1,1,C)=1.,					
Fuel Combustion(C=1)	No variables required				
Industrial Process(C=2)	No variables required				
Solid Waste(C=3)	No variables required				
TAB03(1,1,C)=1.,					
Fuel Combustion(C=1)	No devices excluded				
Industrial Process(C=2)	No devices excluded				
Solid Waste(C=3)	No devices excluded				
TAB04(1,1,C)=1.,					
Fuel Combustion(C=1)	No devices excluded				
Industrial Process(C=2)	No devices excluded				
Solid Waste(C=3)	No devices excluded				
TAB05(1,1,C)=1.,					
Fuel Combustion(C=1)	1.,.198,	100000.,100.,	200000.,100.,	500000.,100.,	1000000000.,100.
Industrial Process(C=2)	1.,.198,	100000.,100.,	200000.,100.,	500000.,100.,	1000000000.,100.
Solid Waste(C=3)	1.,.198,	100000.,100.,	200000.,100.,	500000.,100.,	1000000000.,100.
TAB06(1,1,C)=1.,					
Fuel Combustion(C=1)	1.,.198,	100000.,100.,	200000.,100.,	500000.,100.,	1000000000.,100.
Industrial Process(C=2)	1.,.198,	100000.,100.,	200000.,100.,	500000.,100.,	1000000000.,100.
Solid Waste(C=3)	1.,.198,	100000.,100.,	200000.,100.,	500000.,100.,	1000000000.,100.
TAB07(1,1,C)=1.,					
Fuel Combustion(C=1)	1.,.198,	100000.,100.,	200000.,100.,	500000.,100.,	1000000000.,100.
Industrial Process(C=2)	1.,.198,	100000.,100.,	200000.,100.,	500000.,100.,	1000000000.,100.
Solid Waste(C=3)	1.,.198,	100000.,100.,	200000.,100.,	500000.,100.,	1000000000.,100.
TAB08(1,1,C)=1.,					
Fuel Combustion(C=1)	.001.,6.,	25.,6.,	5000.,1.,	100000.,.38	
Industrial Process(C=2)	N/A				
Solid Waste(C=3)	N/A				

TABLE 7.7-2

PRESET PARAMETERS IN EACH EMISSION STANDARD (SULFUR OXIDE CONTROL STANDARDS) (Continued)

Variable	Preset Parameters
TAB09(1,1,C)=1.,	
Fuel Combustion(C=1)	.001.,1.5, 40.,1.5, 1000.,.6, 100000.,.6
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB10(1.1,C)=1.,	
Fuel Combustion(C=1)	.001.,1.5, 40.,1.5, 1000.,.6, 100000.,.6
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB11(1,1,C)=1.,	
Fuel Combustion(C=1)	50., 1.,6., 28.,6., 7800.,0.1, 100., 1.,6., 41.,6., 9400.,.1. 15.0.,1.,6., 74.,6., 17000.,.1, 225., 1.6., 125.,6., 28000.,.1, 300., 1.,6., 180.,6., 100000.,.16, 600., 1.,6., 430.,6., 1000000.,.22, 800., 1.,6., 640.,6., 100000.,.28
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB12(1,1,C)=1.,	
Fuel Combustion(C=1)	68. 1000. 16.4, 1.,.001926, 32.8,2., 49.1,4.5, 65.5,8., 98.4,17.5, 131.,32., 164.,50., 230.,100., 328.,200., 491.,450., 656.,800., 10000, 183900.
Industrial Process(C=2)	68. 1000. 16.4, 1.,.001926., 32.8,2., 49.1,4.5, 65.5,8., 98.4,17.5, 131.,32., 164.,50., 230.,100., 328.,200., 491.,450., 656.,800., 10000.,183900.
Solid Waste(C=3)	68. 1000. 16.4, 1.,.001926, 32.8,2., 49.1,4.5, 65.5,8., 98,4,17.5, 131.,32., 164.,50., 230.,100., 328.,200., 491.,450., 656.,800., 10000, 183900.
TAB13(1,1,C)=1.,	
Fuel Combustion(C=1)	500.
Industrial Process(C=2)	500.
Solid Waste(C=3)	500.
TAB14(1,1,C)=1.,	
Fuel Combustion(C=1)	2000.
Industrial Process(C=2)	2000.
Solid Waste(C=3)	2000.

TABLE 7.7-2

PRESET PARAMETERS IN EACH EMISSION STANDARD (SULFUR OXIDE CONTROL STANDARDS) (Continued)

Variables	Preset Parameters
TAB15(1,1,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB16(1,1,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB17(1,1,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB18(1,1,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	736.,10., 1000.,12.2, 2000.,19.5, 10000.,57.4, 20000.,91.2, 100000.,268., 200000.,428., 1000000.,1250., 2000000.,2010., 10000000.,5850., 20000000.,9000.
Solid Waste(C=3)	736.,10., 1000.,12.2, 2000.,19.5, 10000.,57.4, 20000.,91.2, 100000.,268., 200000.,428., 1000000.,1250., 2000000.,2010., 10000000.,5850., 20000000.,9000.
TAB19(1,1,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	736.,10., 1000.,12.2, 2000.,19.5, 10000.,57.4, 20000.,91.2, 100000.,268., 200000.,428., 1000000.,1250., 2000000.,2010., 10000000.,5850., 20000000.,9000.
Solid Waste(C=3)	736.,10., 1000.,12.2, 2000.,19.5, 10000.,57.4, 20000.,91.2, 100000.,268., 200000.,428., 1000000.,1250., 2000000.,2010., 10000000.,5850., 20000000.,9000.

TABLE 7.7-2

PRESET PARAMETERS IN EACH EMISSION STANDARD (SULFUR OXIDE CONTROL STANDARDS) (Continued)

Variables	Preset Parameters
TAB20(1,1,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	736.,10., 1000.,12.2, 2000.,19.5, 10000.,57.4, 20000.,91.2, 100000.,268., 200000.,428., 1000000.,1250., 2000000.,2010., 10000000.,5850., 20000000.,9000.
Solid Waste(C=3)	736.,10., 1000.,12.2, 2000.,19.5, 10000.,57.4, 20000.,91.2, 100000.,268., 200000.,428., 1000000.,1250., 2000000.,2010., 10000000.,5850., 20000000.,9000.
TAB21(1,1,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB22(1,1,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB23(1,1,C)=1.,	
Fuel Combustion(C=1)	No variables required
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB24(1,1,C)=1.,	
Fuel Combustion(C=1)	No variables required
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB25(1,1,C)=1.,	
Fuel Combustion(C=1)	No variables required
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB26(1,1,C)=1.,	
Fuel Combustion(C=1)	No value preset; must be input
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A

TABLE 7.7-3

PRESET PARAMETERS IN EACH EMISSION STANDARD (PARTICULATE CONTROL STANDARDS)

Variable	Preset Parameters
TAB01(1,2,C)= 1.,	
Fuel Combustion(C=1)	No variables required
Industrial Process(C=2)	No variables required
Solid Waste(C=3)	No variables required
TAB02(1,2,C)=1.,	
Fuel Combustion(C=1)	No variables required
Industrial Process(C=2)	No variables required
Solid Waste(C=3)	No variables required
TAB03(1,2,C)=1.,	
Fuel Combustion(C=1)	No devices excluded
Industrial Process(C=2)	No devices excluded
Solid Waste(C=3)	No devices excluded
TAB04(1,2,C)=1.,	
Fuel Combustion(C=1)	No devices excluded
Industrial Process(C=2)	No devices excluded
Solid Waste(C=3)	No devices excluded
TAB05(1,2,C)=1.,	
Fuel Combistion(C=1)	N/A
Industrial Process(C=2)	20.,4., 1000.,60., 6000.,60., 30000.,300., 1000000000.,300.
Solid Waste(C=3)	20.,4., 1000.,60., 6000.,60., 30000.,300., 1000000000.,300.
TAB06(1,2,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	.01,.2, 3.,.2, 20.,.2, 100.,1., 1000000.,10000.
Solid Waste(C=3)	.01,.2, 3.,.2, 20.,.2, 100.,1., 1000000.,10000.
TAB07(1,2,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	10.,1.8, 100.,10., 10000.,300., 100000.,300., 1000000.,300.
Solid Waste(C=3)	10.,1.8, 100.,10., 10000.,300., 100000.,300., 1000000.,300.
TAB08(1,2,C)=1.,	
Fuel Combustion(C=1)	.001,.6, 10.,.6, 10000.,.2, 100000.,.2
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A

TABLE 7.7-3

PRESET PARAMETERS IN EACH EMISSION STANDARD (PARTICULATE CONTROL STANDARDS) (Continued)

Variable	Preset Parameters
TAB09(1,2,C)=1.,	
Fuel Combustion(C=1)	.001,.5, 10.,.5, 5000.,.18, 100000.,.18
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB10(1,2,C)=1.,	
Fuel Combustion(C=1)	.001,.6, 10.,.6, 10000.,.11, 100000.,.11
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB11(1,2,C)=1.,	
Fuel Combustion(C=1)	50., 1.,.6, 150.,.6, 1500.,.1, 100., 1.,.6, 300.,.6, 3000.,.108, 150., 1.,.6, 500.,.6, 3000.,.17, 225., 1.,.6, 1100.,.6, 9000.,.12, 300., 1.,.6, 1600.,.6, 20000.,.12, 600., 1.,.6, 7000.,.6, 50000.,.12, 800., 1.,.6, 10000.,.6, 80000.,.12
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB12(1,2,C)=1.,	
Fuel Combustion(C=1)	68., 1000., 16.4, 1.,.001926, 32.8,2., 49.1,4.5, 65.5,8., 98.4,17.5, 131.,32., 164.,50., 230.,100., 328.,200., 491.,450., 656.,800., 10000.,183900.
Industrial Process(C=2)	68., 1000., 16.4, 1.,.001926, 32.8,2., 49.1,4.5, 65.5,8., 98.4,17.5, 131.,32., 164.,50., 230.,100., 328.,200., 491.,450., 656.,800., 10000.,183900.
Solid Waste(C=3)	68., 1000., 16.4, 1.,.001926, 32.8,2., 49.1,4.5, 65.5,8., 98.4,17.5, 131.,32., 164.,50., 230.,100., 328.,200., 491.,450., 656.,800., 10000.,183900.
TAB13(1,2,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A

TABLE 7.7-3

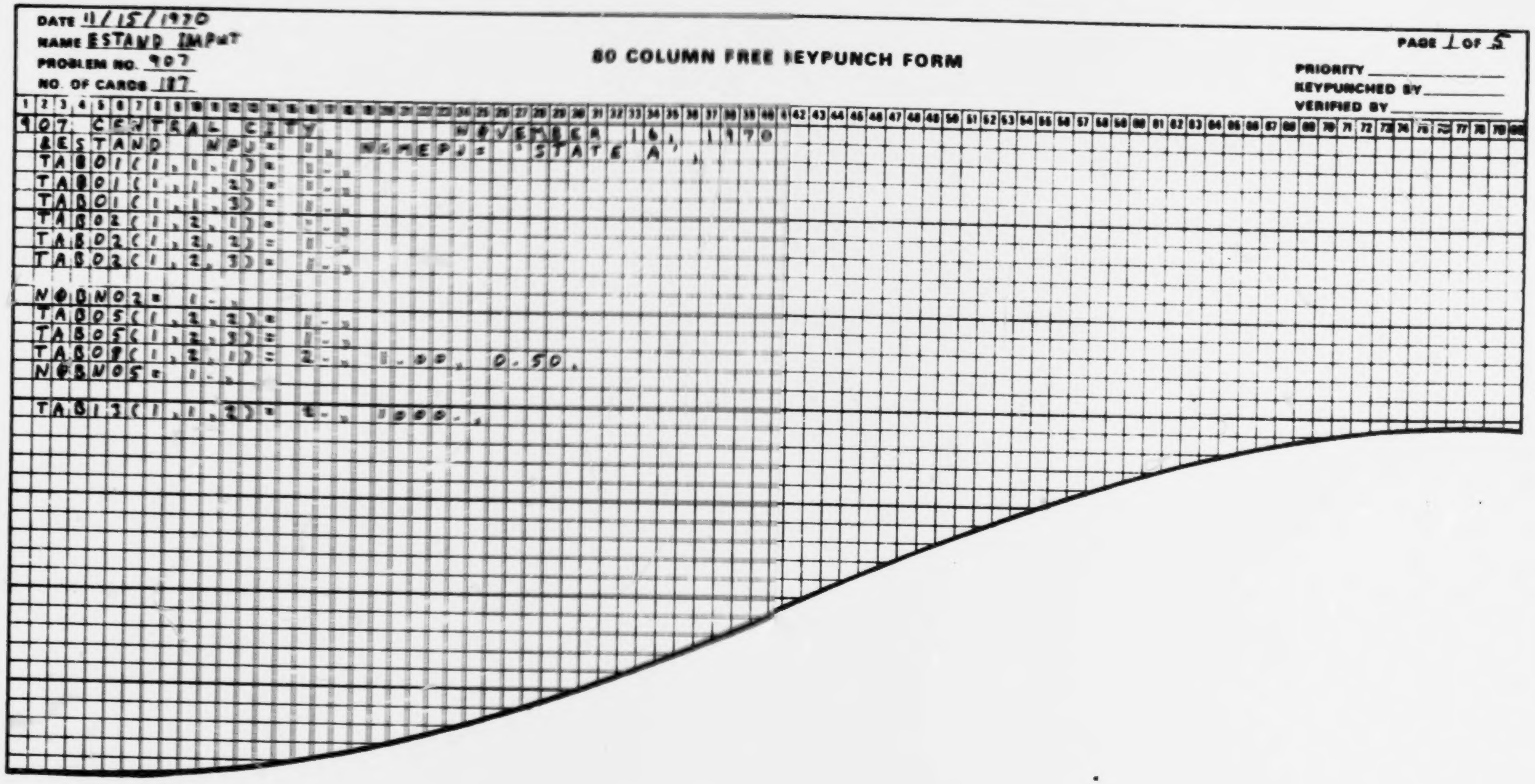
PRESET PARAMETERS IN EACH EMISSION STANDARD (PARTICULATE CONTROL STANDARDS) (Continued)

Variable	Preset Parameters
TAB14(1,2,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB15(1,2,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	.1, 400000., .05
Solid Waste(C=3)	.3, 200., .2
TAB16(1,2,C)=1.,	
Fuel Combustion(C=1)	.05
Industrial Process(C=2)	.15
Solid Waste(C=3)	.2
TAB17(1,2,C)=1.,	
Fuel Combustion(C=1)	.1
Industrial Process(C=2)	.05
Solid Waste(C=3)	.4
TAB18(1,2,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	100.,.551, 400.,1.4, 1000.,2.58, 4000.,6.52, 10000.,12., 40000.,30.5, 60000.,40., 100000.,44.6, 400000.,58.5, 1000000.,69., 6000000.,92.7
Solid Waste(C=3)	10.,.3, 15.,.3, 20.,.3, 25.,.3, 30.,.3, 35.,.3, 40.,.3, 50.,.3, 100.,.5, 70000.,50., 1000000.,350.
TAB19(1,2,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	50.,.24, 300.,1.2, 500.,1.77, 900.,2.62, 1500.,3.54, 4100.,6.01, 11000.,10.63, 30000.,22.22, 40000.,28.3, 60000.,40., 1000000.,40.
Solid Waste(C=3)	10.,.3, 100.,.3, 300.,.87, 320.,1., 680.,2., 1000.,2.9, 4000.,10., 9000.,20., 20000.,40., 70000.,100., 200000.,200.

TABLE 7.7-3

PRESET PARAMETERS IN EACH EMISSION STANDARD (PARTICULATE CONTROL STANDARDS) (Continued)

Variables	Preset Parameters
TAB20(1,2,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	1.,.0126, 400.,.7, 1000.,1.29, 4000.,3.26, 10000.,6., 40000.,15.25, 60000.,20., 100000.,22.3, 400000.,29.2, 6000000.,46.35, 10000000.,50.
Solid Waste(C=3)	50.,.1, 100.,.1, 200.,.1, 300.,.1, 400.,.1, 500.,.1, 1000.,2., 2828.,5., 5000.,8., 10000.,14.1, 50000.,57.
TAB21(1,2,C)=1.,	
Fuel Combustion(C=1)	No value preset; must be input
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB22(1,2,C)=1.,	
Fuel Combustion(C=1)	No value preset; must be input
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB23(1,2,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB24(1,2,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TA325(1,2,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A
TAB26(1,2,C)=1.,	
Fuel Combustion(C=1)	N/A
Industrial Process(C=2)	N/A
Solid Waste(C=3)	N/A



DATE 11/15/1970
NAME ESTAND INPUT
PROBLEM NO. 907
NO. OF CARDS 187

80 COLUMN FREE KEYPUNCH FORM

PAGE 1 OF 5
PRIORITY
KEYPUNCHED BY
VERIFIED BY

```
907  CENTRAL CITY           NOVEMBER 16, 1970
 &ESTAND  NPJ = 1, NAMEPJ = 'STATE A',
 TAB01(1,1,1) = 1.,
 TAB01(1,1,2) = 1.,
 TAB01(1,1,3) = 1.,
 TAB02(1,2,1) = 1.,
 TAB02(1,2,2) = 1.,
 TAB02(1,2,3) = 1.,

 NOBNO2= 1.,
 TAB05(1,2,2) = 1.,
 TAB05(1,2,3) = 1.,
 TAB09(1,2,1) = 2., 1.00, 0.50,
 NOBNO5= 1.,

 TAB13(1,1,2) = 1., 1000.,
```

Figure 7.7-4. Example Input Data Form for the Emission Standards Program.

7.7.4 Output

The Emission Standards Program produces both printed output (under two formats) and a magnetic tape record. The content of these outputs is described in the following paragraphs and example outputs are shown in Figures 7.7-5 and 7.7-6.

Emission Standard Input (Figure 7.7-5)

The input variables prepared by the user to define the Emission Standards Program run are incorporated as a part of the printed output as shown in this figure. The regional identification, code number and name, begins each output section. The emission standards selected by the user are then printed on a political jurisdiction basis. For each emission standard, the preset values (if any) are printed. If the user has elected to modify these preset values for a particular emission standard, the modification will be shown in this output. This table provides a complete listing of the emission standards which are available for control strategy development and simulation in the Regional Strategy Program.

Emission Standards (Figure 7.7-6)

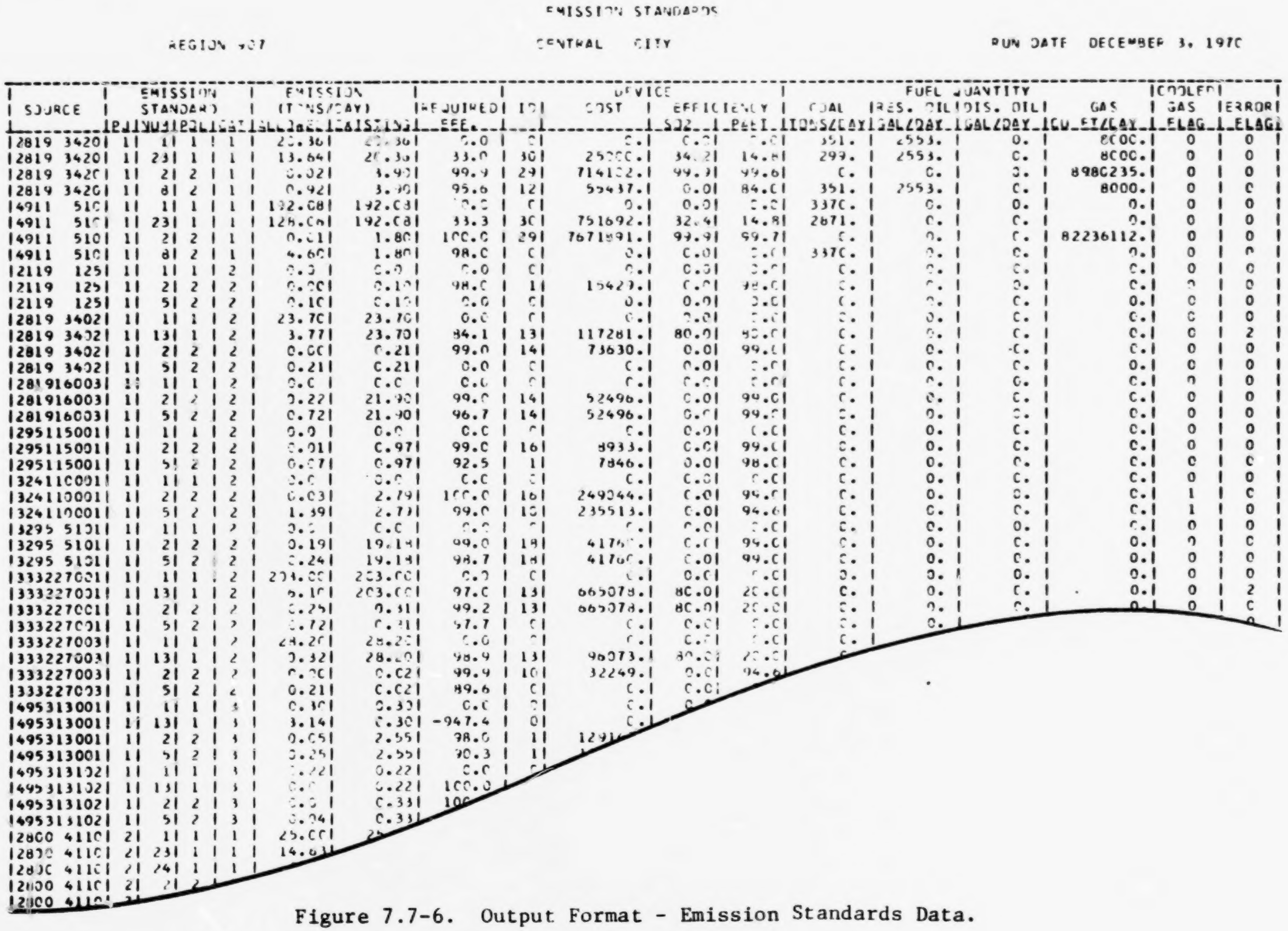
The major output produced by the Emission Standards Program is shown in this figure. The major column headings in this output are as follows:

- Source. Each source is identified by its nine digit identification number.
- Emission Standard. The emission standard applied to each source is identified by four parameter values. The source's political jurisdiction defines which set of emission standards are applied and also indicates, in conjunction with the other parameters, which set of preset or user input data were used in computing the allowable emissions. "Num" identifies the emission standard being applied, the number refers to the coded description in Chapter 6 defining the emission standards. "Pol" is the coded identification of the pollutant being controlled; one refers to sulfur dioxide, two refers to particulates. "Cat" identifies the source category with one for fuel combustion, two for industrial process and three for solid waste disposal. Together, these values completely define the specific emission standard being applied.

```
                                    EMISSION STANDARD INPUT

REGION 927    CENTRAL    CITY

POLITICAL JURISDICTION  1     STATE A

TAB01(1,1,1)= 1.

TAB01(1,1,2)= 1.

TAB01(1,1,3)= 1.

TAB02(1,2,1)= 1.,

TAB02(1,2,2)= 1.,

TAB02(1,2,3)= 1.,
NOHNC2= 1.

TAB05(1,2,2)= 1.,         20.   4.000.      1000.  60.000,      5000.  60.000.      30000. 300.000,1000000000

TAB05(1,2,3)= 1.,         20.   4.000.      1000.  60.000,      6000
NOBNC5= 0.

TAB08(1,2,1)= 2.,       1.000.       [illegible]

TAB13(1,1,2)= 2.,1000.00.

TAB13(1,1,3)= 1., 500.

TAB23(1,1,1)
```

Figure 7.7-5. Output Format - Input Data.

NOT REPRODUCIBLE



```
                                        EMISSION STANDARDS

           REGION 407                      CENTRAL   CITY                               RUN DATE  DECEMBER 3, 1970

-----------------------------------------------------------------------------------------------------------------------------------
|           |   EMISSION    |   EMISSION        |         |                DEVICE            |            FUEL QUANTITY                   |COOLED|      |
| SOURCE    |   STANDARD    |  (TONS/DAY)       |REQUIRED | ID|     COST  |  EFFICIENCY   |  COAL   |RES. OIL |DIS. OIL |    GAS      | GAS  |ERROR|
|___________|PJ|NUM|POLICY|CAT|ALLOWED|EXISTING| EFF.    |   |           | SO2   | PART  |TONS/DAY |GAL/DAY  |GAL/DAY  |CU FT/DAY    | FLAG | FLAG|
|2819 3420| 1|  1| 1 | 1 |  20.36|  20.36|   0.0 |  0|        0.|  0.0|  0.0|   351. |  2553. |      0. |      8000.|  0  |  0 |
|2819 3420| 1| 23| 1 | 1 |  13.64|  20.36|  33.0 | 30|    25000.| 34.2| 14.8|   299. |  2553. |      0. |      8000.|  0  |  0 |
|2819 3420| 1|  2| 2 | 1 |   0.02|   3.90|  99.9 | 29|   714102.| 99.3| 99.6|     0. |     0. |      0. |   8980235.|  0  |  0 |
|2819 3420| 1|  8| 2 | 1 |   0.92|   3.90|  95.6 | 12|    55437.|  0.0| 84.0|   351. |  2553. |      0. |      8000.|  0  |  0 |
|4911  510| 1|  1| 1 | 1 | 192.08| 192.08|   0.0 |  0|        0.|  0.0|  0.0|  3370. |     0. |      0. |         0.|  0  |  0 |
|4911  510| 1| 23| 1 | 1 | 128.06| 192.08|  33.3 | 30|   751692.| 32.4| 14.8|  2871. |     0. |      0. |         0.|  0  |  0 |
|4911  510| 1|  2| 2 | 1 |   0.01|   1.80| 100.0 | 29|  7671891.| 99.9| 99.7|     0. |     0. |      0. |  82236112.|  0  |  0 |
|4911  510| 1|  8| 2 | 1 |   4.60|   1.80|  98.0 |  0|        0.|  0.0|  0.0|  3370. |     0. |      0. |         0.|  0  |  0 |
|2119  125| 1|  1| 1 | 2 |   0.0 |   0.0 |   0.0 |  0|        0.|  0.0|  0.0|     0. |     0. |      0. |         0.|  0  |  0 |
|2119  125| 1|  2| 2 | 2 |   0.00|   0.10|  98.0 |  1|    15420.|  0.0| 98.0|     0. |     0. |      0. |         0.|  0  |  0 |
|2119  125| 1|  5| 2 | 2 |   0.10|   0.10|   0.0 |  0|        0.|  0.0|  0.0|     0. |     0. |      0. |         0.|  0  |  0 |
|2819 3402| 1|  1| 1 | 2 |  23.70|  23.70|   0.0 |  0|        0.|  0.0|  0.0|     0. |     0. |      0. |         0.|  0  |  0 |
|2819 3402| 1| 13| 1 | 2 |   3.77|  23.70|  84.1 | 13|   117281.| 80.0| 80.0|     0. |     0. |      0. |         0.|  0  |  2 |
|2819 3402| 1|  2| 2 | 2 |   0.00|   0.21|  99.0 | 14|    73630.|  0.0| 99.0|     0. |     0. |     -0. |         0.|  0  |  0 |
|2819 3402| 1|  5| 2 | 2 |   0.21|   0.21|   0.0 |  0|        0.|  0.0|  0.0|     0. |     0. |      0. |         0.|  0  |  0 |
|281916003| 1|  1| 1 | 2 |   0.0 |   0.0 |   0.0 |  0|        0.|  0.0|  0.0|     0. |     0. |      0. |         0.|  0  |  0 |
|281916003| 1|  2| 2 | 2 |   0.22|  21.90|  99.0 | 14|    52496.|  0.0| 99.0|     0. |     0. |      0. |         0.|  0  |  0 |
|281916003| 1|  5| 2 | 2 |   0.72|  21.90|  96.7 | 14|    52496.|  0.0| 99.0|     0. |     0. |      0. |         0.|  0  |  0 |
|295115001| 1|  1| 1 | 2 |   0.0 |   0.0 |   0.0 |  0|        0.|  0.0|  0.0|     0. |     0. |      0. |         0.|  0  |  0 |
|295115001| 1|  2| 2 | 2 |   0.01|   0.97|  99.0 | 16|     8933.|  0.0| 99.0|     0. |     0. |      0. |         0.|  0  |  0 |
|295115001| 1|  5| 2 | 2 |   0.07|   0.97|  92.5 |  1|     7846.|  0.0| 98.0|     0. |     0. |      0. |         0.|  0  |  0 |
|324110001| 1|  1| 1 | 2 |   0.0 |   0.0 |   0.0 |  0|        0.|  0.0|  0.0|     0. |     0. |      0. |         0.|  0  |  0 |
|324110001| 1|  2| 2 | 2 |   0.03|   2.79| 100.0 | 16|   249044.|  0.0| 99.0|     0. |     0. |      0. |         0.|  1  |  0 |
|324110001| 1|  5| 2 | 2 |   1.39|   2.77|  99.0 | 10|   235513.|  0.0| 94.6|     0. |     0. |      0. |         0.|  1  |  0 |
|3295 5101| 1|  1| 1 | 2 |   0.0 |   0.0 |   0.0 |  0|        0.|  0.0|  0.0|     0. |     0. |      0. |         0.|  0  |  0 |
|3295 5101| 1|  2| 2 | 2 |   0.19|  19.18|  99.0 | 18|    41760.|  0.0| 99.0|     0. |     0. |      0. |         0.|  0  |  0 |
|3295 5101| 1|  5| 2 | 2 |   0.24|  19.18|  98.7 | 18|    41760.|  0.0| 99.0|     0. |     0. |      0. |         0.|  0  |  0 |
|333227001| 1|  1| 1 | 2 | 203.00| 203.00|   0.0 |  0|        0.|  0.0|  0.0|     0. |     0. |      0. |         0.|  0  |  0 |
|333227001| 1| 13| 1 | 2 |   6.10| 203.00|  97.0 | 13|   665078.| 80.0| 20.0|     0. |     0. |      0. |         0.|  0  |  2 |
|333227001| 1|  2| 2 | 2 |   0.25|   0.31|  99.2 | 13|   665078.| 80.0| 20.0|     0. |     0. |      0. |         0.|  0  |  0 |
|333227001| 1|  5| 2 | 2 |   0.72|   0.31|  57.7 |  0|        0.|  0.0|  0.0|     0. |     0. |
|333227003| 1|  1| 1 | 2 |  28.20|  28.20|   0.0 |  0|        0.|  0.0|  0.0|     0. |
|333227003| 1| 13| 1 | 2 |   0.32|  28.20|  98.9 | 13|    96073.| 80.0| 20.0|
|333227003| 1|  2| 2 | 2 |   0.00|   0.02|  99.9 | 10|    32249.|  0.0| 94.6
|333227003| 1|  5| 2 | 2 |   0.21|   0.02|  89.6 |  0|        0.|  0.0
|495313001| 1|  1| 1 | 3 |   0.30|   0.30|   0.0 |  0|        0.|
|495313001| 1| 13| 1 | 3 |   3.14|   0.30|-947.4 |  0|        0.|
|495313001| 1|  2| 2 | 3 |   0.05|   2.55|  98.0 |  1|     1291
|495313001| 1|  5| 2 | 3 |   0.25|   2.55|  90.3 |  1|
|495313102| 1|  1| 1 | 3 |   0.22|   0.22|   0.0 |  0|
|495313102| 1| 13| 1 | 3 |   0.0 |   0.22| 100.0 |
|495313102| 1|  2| 2 | 3 |   0.0 |   0.33| 100
|495313102| 1|  5| 2 | 3 |   0.04|   0.33|
|2800 4110| 2|  1| 1 | 1 |  25.00|  25
|2800 4110| 2| 23| 1 | 1 |  14.6
|2800 4110| 2| 24| 1 | 1 |
|2800 4110| 2|  2| 2
|2800 411
```

Figure 7.7-6. Output Format - Emission Standards Data.

NOT REPRODUCIBLE

- Emission. The source's existing emission rate for the pollutant identified in the standard is shown in this column. The calculated allowable emission is also presented in this column.
- Required Efficiency. The total pollutant removal efficiency required to bring each source into compliance with the emission standard is displayed in this column. This efficiency is that required of a completely uncontrolled source. If any control equipment is already installed, the pollutant removal efficiency needed from an additional control device will be less than the "Required Efficiency."
- Device. The control device selected by the Emission Standards Program is identified and described by the four variables under this column heading. "ID" gives the device identification number (see Table 5-2). "Cost" is the total annualized cost of applying this device to the source. The makeup and calculation of this cost were described in Chapter 5. "Efficiency" presents the decimal pollutant removal efficiency for both pollutants.
- Fuel Quantity. The fuel usage pattern for each source as modified to meet the specified emission standard is displayed under this heading. These values are non-zero only for fuel combustion type sources. Usage rates are displayed for coal, residual fuel oil, distillate fuel oil and natural gas.
- Cooled Gas Flag. This column indicates whether or not exhaust gas cooling was required before application of the control device. A complete discussion of the concept of gas cooling was given in Chapter 5.
- Error Flag. A value other than zero in this column indicates that an error was encountered in the application of this standard or in the selection of an appropriate control device. A numeral one indicates that some error was encountered in applying the standard. The user will also receive a printed diagnostic error message specifically identifying the type of error (see Chapter 8). A numeral two indicates that the most efficient control device has been applied but that the allowable emission rate was not attained. No other error messages are generated by this type of error.

Magnetic Tape Output

This output provides the basic data required for the execution of the Regional Strategies Program. It contains the data included in the Emission Standards printed output as well as certain other variables that are merely transmitted from the Control Cost Program to the Strategies section. A more detailed description of the makeup and uses of this file is presented in Sections 7.8 and 7.9.

7.8 EMISSION STANDARDS FILE UPDATE PROGRAM

7.8.1 Description

The Emission Standards File Update Program is a COBOL program designed to change, delete or add records to the Emission Standards File. In addition, the program will produce a formatted listing of the new file after each update run is completed.

Input to the program consists of the Emission Standards File, on magnetic tape or disk, and punched cards describing the data which is to be added, changed, or deleted. The overall system flow of the Update Program is shown in Figure 7.8-1.

7.8.2 JCL Cards and Deck Setup

An example deck setup configuration is illustrated in Figure 7.8-2. Figure 7.8-3 contains the specific JCL cards, corresponding to the deck setup, which were used for the installation test case. The test case setup was based on the following configuration:

(a) Update program in object deck form

(b) Control Cost File on magnetic tape

Deviations from this configuration require appropriate JCL card changes.

7.8.3 Program Input

The update of the Emission Standards File is accomplished by means of fixed format punched cards. The description of the data fields for each record is given in Table 7.8-1. An example data form with prepared inputs is illustrated in Figure 7.8-4. The input requirements for each of the program operations is as follows:

(a) Record addition (Transaction Code = A) - All of the data shown in Table 7.8-1 must be completed. If the Standard Number (01 through 26) being simulated by the addition is on the existing File (for the same pollutant-source category-political jurisdiction), a new number (27 and on) must be used. If this is not done, the Regional Strategies program cannot utilize the addition.

(b) Record change (Transaction Code = C) - The first 19 columns must be completed; followed by only those data elements to be changed.

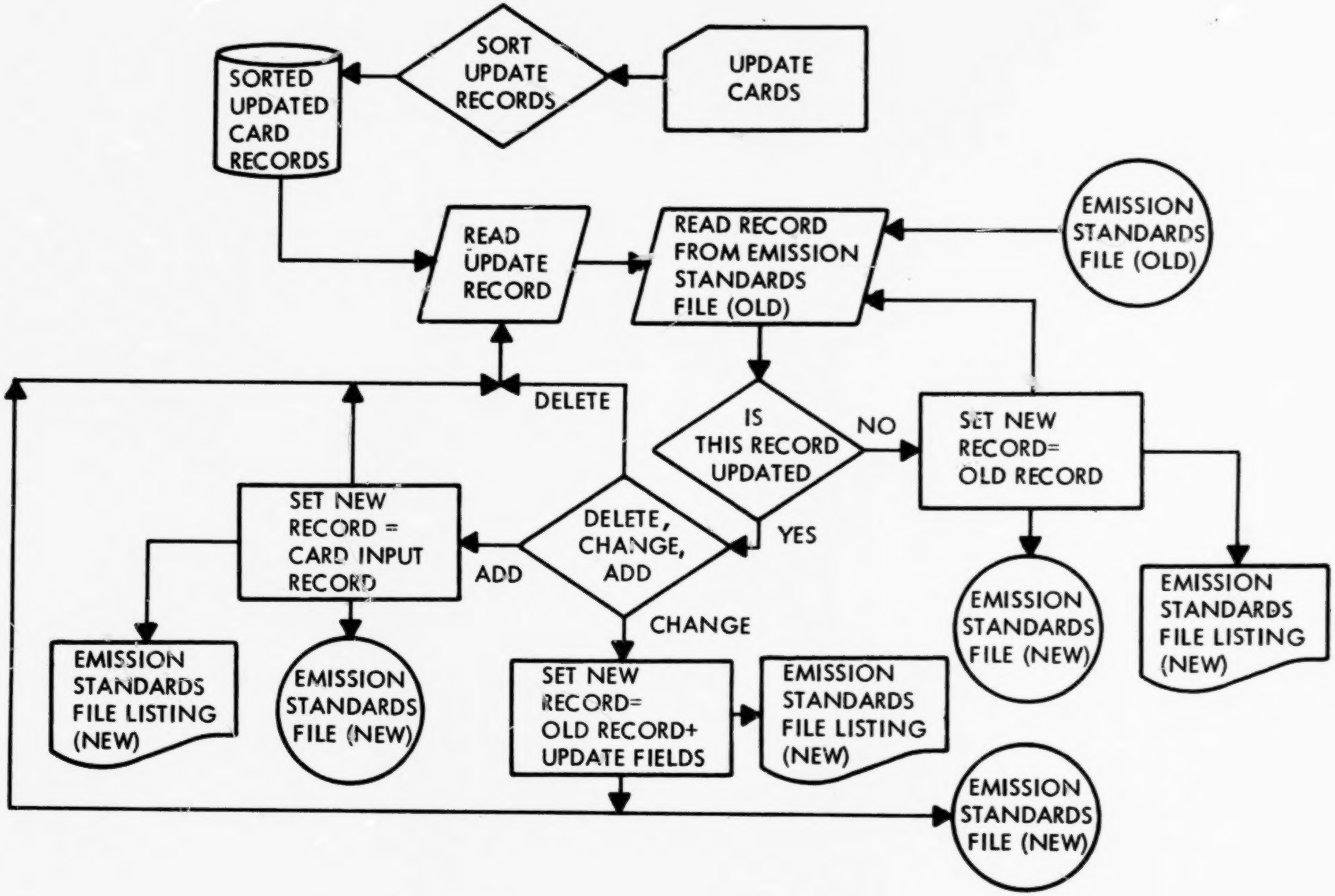

UPDATE CARDS
SORT UPDATE RECORDS
SORTED UPDATED CARD RECORDS
READ UPDATE RECORD
READ RECORD FROM EMISSION STANDARDS FILE (OLD)
EMISSION STANDARDS FILE (OLD)
IS THIS RECORD UPDATED
NO
YES
SET NEW RECORD= OLD RECORD
EMISSION STANDARDS FILE (NEW)
EMISSION STANDARDS FILE LISTING (NEW)
DELETE, CHANGE, ADD
DELETE
ADD
CHANGE
SET NEW RECORD = CARD INPUT RECORD
EMISSION STANDARDS FILE LISTING (NEW)
EMISSION STANDARDS FILE (NEW)
SET NEW RECORD= OLD RECORD+ UPDATE FIELDS
EMISSION STANDARDS FILE LISTING (NEW)
EMISSION STANDARDS FILE (NEW)

Figure 7.8-1. Emission Standards File Update Program Flow

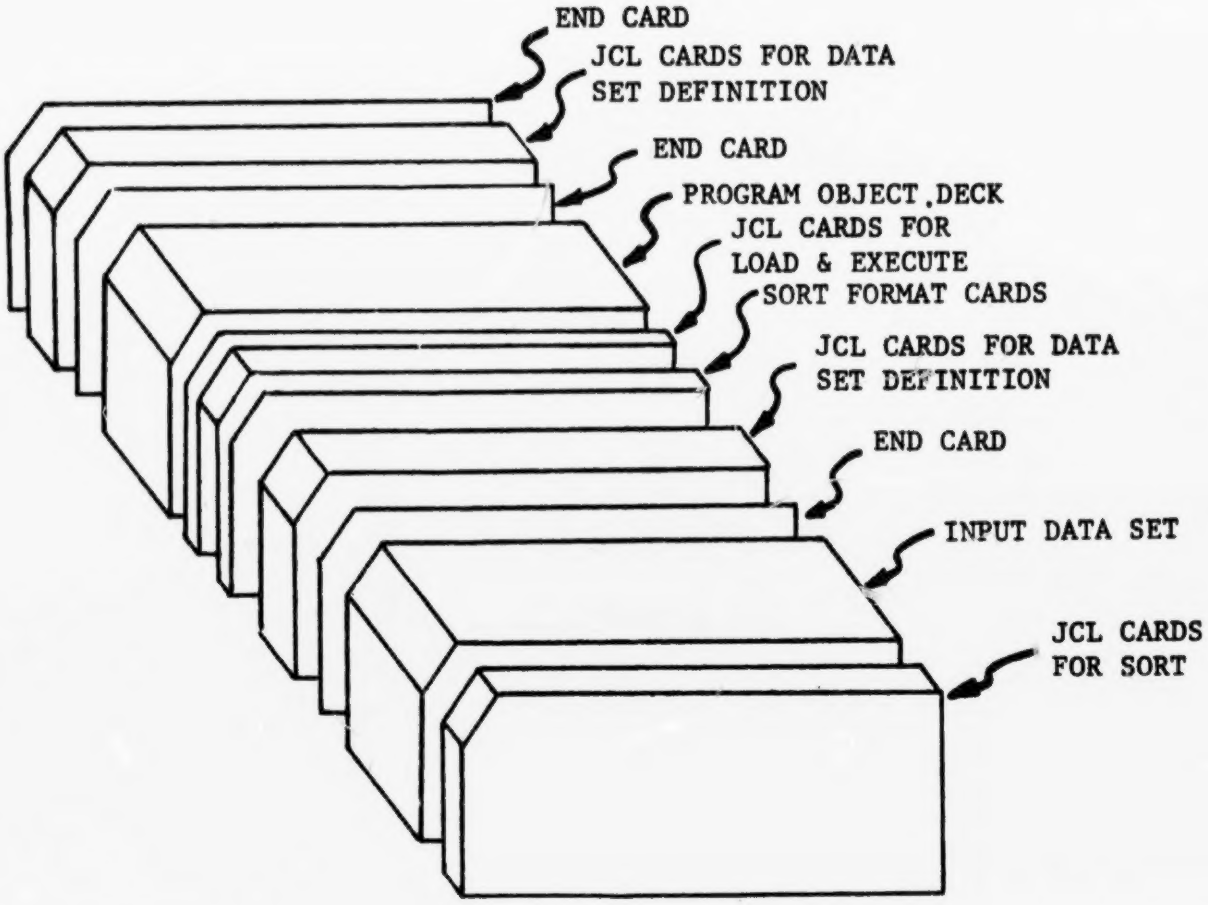

END CARD
JCL CARDS FOR DATA SET DEFINITION
END CARD
PROGRAM OBJECT DECK
JCL CARDS FOR LOAD & EXECUTE
SORT FORMAT CARDS
JCL CARDS FOR DATA SET DEFINITION
END CARD
INPUT DATA SET
JCL CARDS FOR SORT

Figure 7.8-2. Example Deck Configuration for the Emission Standards File Update Program.

```
                                  ESTAND UPDATE DECK SETUP

SORT           { //STEP2   EXEC  PROC=SORT
               { //SORTIN  DD  *

DATA SET         **********          TRANSACTION CARDS HERE                         **********
END CARD         /*
               { //SORTOUT DD DSN=&UPOUT,DISP=(NEW,PASS),UNIT=SYSDA,SPACE=(TRK,(5,1)),
               { //             DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
DATA SET       { //SORTWK01  DD  UNIT=SYSDA,SPACE=(CYL,(50),,CONTIG)
DEFINITION     { //SORTWK02  DD  UNIT=SYSDA,SPACE=(CYL,(50),,CONTIG)
               { //SORTWK03  DD  UNIT=SYSDA,SPACE=(CYL,(50),,CONTIG)
               { //SYSIN  DD  *
SORT FORMAT    {  SORT FIELDS=(14,3,BI,A,5,9,BI,A,17,3,BI,A,1,1,BI,D),SIZE=E10
               {  END
                 /*
LOAD AND       { //STEP2    EXEC COBFLG
EXECUTE        { //LKED.SYSIN  DD  *

PROGRAM DECK     **********               OBJECT DECK HERE                          **********
END CARD         /*
               { //GO.OLDFILE DD DSN=ESFILE,UNIT=2400,VOL=SER=003552,DISP=OLD
DATA SET       { //GO.NEWFILE DD DSN=ESFILE,UNIT=2400,DISP=(NEW,KEEP),
DEFINITION     { //       DCB=(RECFM=VBS,BLKSIZE=1684)
               { //GO.PRINTER DD SYSOUT=A
               { //GO.SORTOUT  DD DSN=&UPOUT,UNIT=SYSDA,DISP=(OLD,PASS)
END CARD         /*
```

Figure 7.8-3. Example JCL Card Setup for the Emission Standards File Update Program.

TABLE 7.8-1

PUNCHED CARD INPUT FOR EMISSION STANDARD FILE UPDATE PROGRAM

Columns	Picture*	Description
1	A	Transaction Code - Enter A if an entire record is to be added, D if an entire record is to be deleted, C if a record is to be changed.
2-4	XXX	Region Number - (001 through 999)
5-8	XXXX	SIC Code - (four digits)
9-11	XXX	Site Number - (001 through 999)
12-13	XX	Process Code - (00 through 99)
14-15	XX	Political Jurisdiction - (01 through 10)
16	X	Source Type - Enter 1 for fuel combustion, 2 for industrial process, 3 for solid waste disposal.
17	X	Pollutant Type - Enter 1 for SO_2 or 2 for particulates.
18-19	XX	Emission Standard Number - (01 through 26, see text for exclusions)
20-22	XXX	Device Number - (001 through 999)
23-31	XXXXXXXX	Cost - Total annual cost, dollars
32-34	.XXX	SO_2 Control Device Efficiency - Decimal equivalent
35-37	.XXX	Particulate Device Efficiency - Decimal equivalent
38-40	.XXX	Total Required Efficiency - Defined as: [potential emission minus allowable emission]/potential emission
41-47	XXXX.XX	Allowed Emissions - tons/day
48-54	XXXX.XX	Existing Emissions - tons/day
55	X	Gas Cooling Flag - Set flag = 0 for no gas cooling, set flag = 1 if gas cooling was used.
56-60	XXXXX	Quantity of Coal Used - tons/day

---

* See footnote on following page.

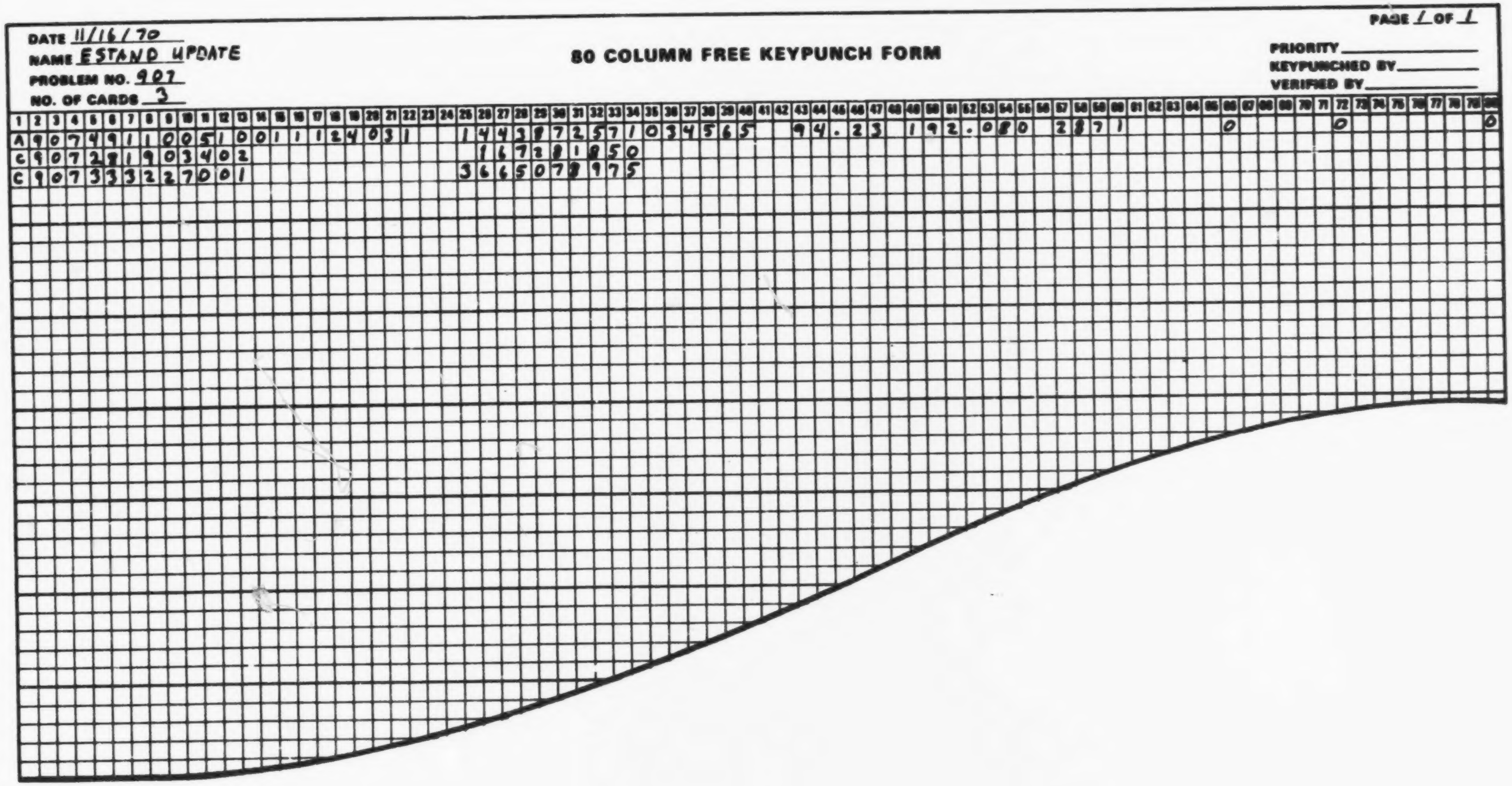
TABLE 7.8-1

PUNCHED CARD INPUT FOR EMISSION STANDARD FILE UPDATE PROGRAM (Continued)

Columns	Picture*	Description
61-66	XXXXXX	Quantity of Residual Oil Used - tons/day
67-72	XXXXXX	Quantity of Distillate Oil Used - tons/day
73-80	XXXXXXXX	Quantity of Gas Used - ft^3/day

---

* NOTE:
1. All decimal points are implied.
2. All numeric values are right justified.
3. Since only those fields to be changed are input, blank fields are acceptable.
4. Within each field there can be no right justified blanks, i.e., all field entries must end with appropriate alphanumeric values.



PAGE 1 OF 1

DATE 11/16/70

NAME ESTAND UPDATE

PROBLEM NO. 907

NO. OF CARDS 3

80 COLUMN FREE KEYPUNCH FORM

PRIORITY

KEYPUNCHED BY

VERIFIED BY

```
A907491100510011124031  1443872571034565  94.23 192.080 2871     0     0       0
C907281903402            167381850
C907333227001           3665078975
```

Figure 7.8-4. Example Input Data Form for the Emission Standards File Update Program.

(c) Record deletion (Transaction Code = D) - Only the first 19 columns need be completed.

Since the program automatically sorts the input cards, the user is not required to maintain any special card input order to the program.

7.8.4 Program Outputs

The principal output of the program is the updated Emission Standards File. A printed listing of the Emission Standards File contents is automatically obtained after each update run. The format of the printed listing from this program is identical to the Emission Standards Application Data Output (Figure 7.7-6).

7.9 REGIONAL STRATEGIES PROGRAM

7.9.1 Description

The Regional Strategies Program is designed to select and summarize particular emission standards application results. The program requires inputs from the following:

(a) Emission Standards File (Section 7.7) - provides the source and device characteristics which satisfy each emission standard applied in the Emission Standards Program.

(b) Source File (Section 7.2) - provides area source data for air quality calculations.

(c) Source Contribution File (Section 7.4) - provides the pollutant contribution from each source, defined in the source file, to each receptor, defined by the Air Pollution Concentration Program.

(d) Punched Card Input (Section 7.9.3) - provides information on the emission standards set (strategy) to be applied, scale factors for area sources and projection factors for all sources.

A control strategy is defined by specifying the following types of data:

(a) Pollutant to be controlled

(b) Emission standard number which is to be applied to:

- Fuel combustion sources in political jurisdiction 1
- Industrial process sources in political jurisdiction 1
- Solid waste sources in political jurisdiction 1
- Fuel combustion sources in political jurisdiction 2
-
-
-
-
-
- Solid waste sources in political jurisdiction N (where N is the total number of political jurisdictions defined for the region).

(c) Statistical parameters for statistical data output associated with the air quality calculations.

(d) Scale factors for area source emission alterations.

(e) Projection factors to be applied to both point source and area source emissions.

If the Source Contribution File is unavailable, new air quality values cannot be computed. Summaries of new emission rate data and control costs will however, be output. For such cases, items (c) and (e) are not required inputs.

7.9.2 JCL and Deck Setup

The input deck setup is illustrated in Figure 7.9-1. Figure 7.9-2 contains the specific JCL cards, corresponding to Figure 7.9-1, which were used for the installation test case setup. The test setup assumes the following:

(a) Regional Strategies Program in object deck form.

(b) Emission Standards File and Source Contribution File on magnetic tape.

(c) Source File on disk.

Deviations from this configuration require appropriate JCL card changes.

7.9.3 Input

The Data Set is composed of from 1 to n strategy definition sets. Each strategy is composed of the punched card input data described in Table 7.9-1. An example data form with prepared inputs is illustrated in Figure 7.9-3.

7.9.4 Output

The following paragraphs display and describe the printed output produced by the Regional Strategies Program.

Input Control Strategy (Figure 7.9-4)

This figure displays the set of emission control standards selected by the user to make up a control strategy. The table header indicates the regional descriptive name, the control strategy identification number

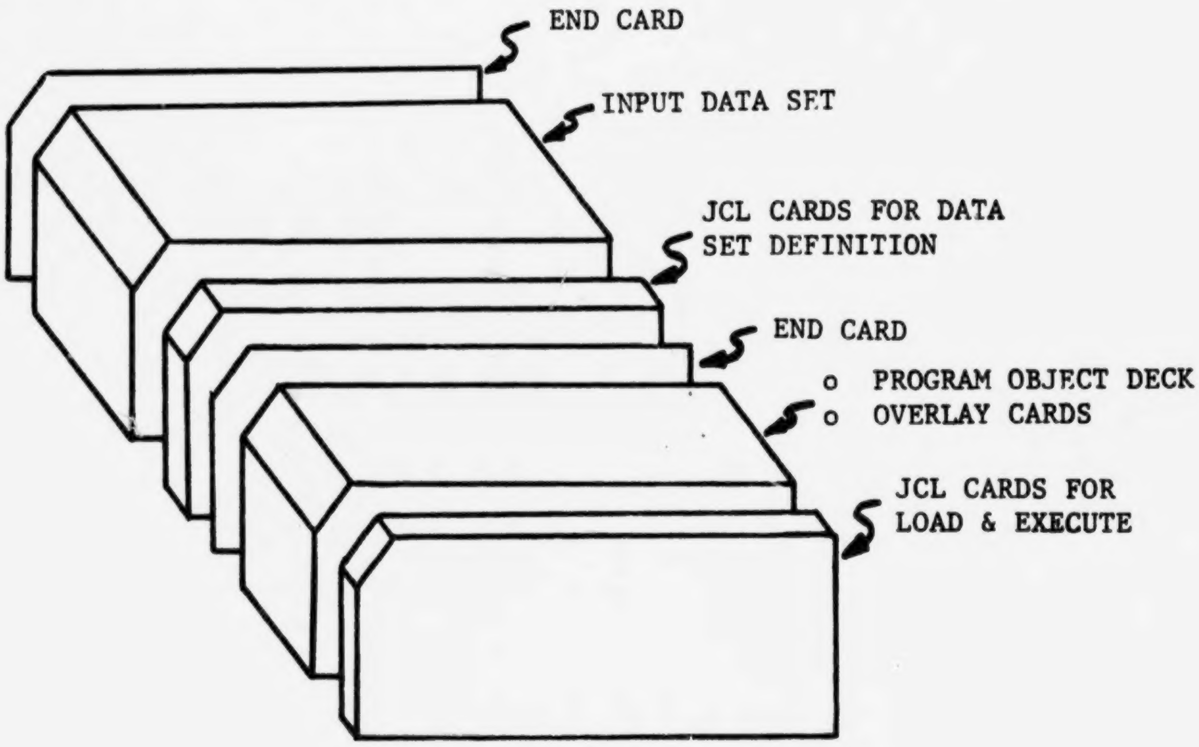

END CARD
INPUT DATA SET
JCL CARDS FOR DATA SET DEFINITION
END CARD
o PROGRAM OBJECT DECK
o OVERLAY CARDS
JCL CARDS FOR LOAD & EXECUTE

Figure 7.9-1. Example Deck Configuration for the Regional Strategies Program

```
                                                 RSTRAT DECK SETUP

LOAD AND          //          EXEC PROC=FORTGLG,PARM.LKED='LET,LIST,XREF,OVLY'
EXECUTE           //LKED.SYSIN DD *
                  **********              OBJECT DECK HERE                              **********

PROGRAM OBJECT     OVERLAY A
DECK AND           INSERT  SRCTAB,JURSUM
OVERLAY CARDS      OVERLAY A
                   INSERT  SUMMRY,RECOUT,PROJEC
                   OVERLAY A
                   INSERT  STATS,ZVALU2
                  /*
                  //GO.FT08FCC1  DD   DSN=&PROJAS,UNIT=SYSDA,DISP=(NEW,DELETE),
                  //    DCB=(RECFM=VBS,LRECL=20,BLKSIZE=204),SPACE=(TRK,(5,1))
                  //GO.FT09FC01  DD   DSN=ESFILE,VOL=SER=000552,UNIT=2400,DISP=OLD,
                  //                LABEL=(,SL,,IN)
DATA SET          //GO.FT10FCC1 DD DSN=SCF9C7,UNIT=2400,LABEL=(,SL,,IN),VOL=SER=000443,
DEFINITION        // DISP=OLD
                  //GO.FT11FC01  DD  DSN=NEWSORCE,VOL=SER=C00078,UNIT=2314,DISP=OLD
                  //GO.FT12FCC1  DD  DSN=&EMSAVE,UNIT=SYSDA,DISP=(NEW,PASS),
                  //               DCB=(RECFM=VSB,LRECL=28,BLKSIZE=564),SPACE=(TRK,(5,1))
                  //GO.SYSIN   DD  *

DATA SET          **********              NAMELIST AND FIXED FORMAT DATA HERE            **********
END CARD          /*
```

Figure 7.9-2. Example JCL Card Setup for the Regional Strategies Program.

TABLE 7.9-1

PUNCHED CARD INPUTS FOR THE REGIONAL
STRATEGIES PROGRAM

Data Type	Description
MN	&RSTRT - A NAMELIST variable indicating start of a list of namelist inputs to the Emission Standards Model. No equal sign or values are associated with this variable.
MNI	NREGØN - Three digit code number for the region to be controlled (see Appendix B for correlation between region numbers and names).
ONA	REGIØN - Up to 72 characters (preceded by an apostrophe and followed by an apostrophe and comma) for the identification of both the region to be controlled (see Appendix B for correlation between region numbers and names) and the strategy being used.
ONA	DATE - Up to 20 characters (preceded by an apostrophe and followed by an apostrophe and comma) for the date of run.
MNI	IJUR - Total number of political jurisdictions in the region.
ONP	SØ2CAL - Regression line constants (y-intercept and slope) for sulfur dioxide. If omitted, the values used in the Air Pollutant Concentration Program (and contained on the Source Contribution File) will be used.
ONP	PARCAL - Regression line constants (y-intercept and slope) for particulate matter. If omitted, the values used in the Air Pollutant Concentration Program (and contained on the Source Contribution File) will be used.
ONP	AQSTAN - Air quality standard for each pollutant (arithmetic mean in micrograms per cubic meter) input in the order: SO_2 and particulate matter. If omitted, a value of 0.0 is used for each pollutant.
ONP	UTM - x and y coordinates of the UTM origin, for translation of the output receptor coordinates. If omitted, a value of 0.0 is used for each coordinate.
ONP	BACKGR - Background concentrations (arithmetic mean, micrograms per cubic meter) for each pollutant in the order: SO_2, particulate matter. If omitted background values are assumed to be zero.

TABLE 7.9-1

PUNCHED CARD INPUTS FOR THE REGIONAL STRATEGIES PROGRAM (Continued)

Data Type	Description
ONI	IPUNCH - Flag to indicate whether receptor ground level concentration output is to be punched on cards for use in plotting concentration isopleths. Set to one (1) if punched card output is desired. If omitted, punched card output will not be produced.
ONI	NSEL12 - Flag to indicate whether statistical output is desired. Set to one (1) if output is desired. If output is requested, the following variables must also be input: If SO_2 strategy, input ISTATS, S02AUG, SO2PER and SGDS. If particulate strategy, input ISTATP, PARAVG, PARPER and SGDP. If omitted, statistical output will not be produced.
ONI	ISTATS* - Twelve (12) receptor numbers for SO_2 statistical output.
ONI	ISTATP - Twelve (12) receptor numbers for particulate matter statistical output.
ONP	S02AVG - Three (3) averaging times (hours) for the SO_2 statistical output.
ONP	PARAVG - Three (3) averaging times (hours) for the particulate matter statistical output
ONP	S02PER - Three (3) percentile levels (percent) for SO_2 statistical output.
ONP	PARPER - Three (3) percentile levels (percent) for particulate matter statistical output.
ONP	SGDS - Standard geometric deviation (24-hour period) for SO_2 corresponding to the ISTATS receptor numbers. These values must be input in the same order as the receptor location numbers to which they refer.

---

*Receptor location numbers must be consistent with the system defined for the associated Air Pollutant Concentration Program run (or Source Contribution File Merge Program run, if applicable).

TABLE 7.9-1

PUNCHED CARD INPUTS FOR THE REGIONAL STRATEGIES PROGRAM (Continued)

Data Type	Description
ONP	SGDP - Standard geometric deviation (24-hour period) for particulate matter corresponding to the ISTATP receptor numbers. These values must be input in the same order, as the receptor location numbers to which they refer.
ONI	IFAC - Flag to indicate whether individual area source scaling factors are input. Set to one (1) if individual scaling factors are input. If omitted, individual scaling factors will not be considered.
ONP	ASFAC - Area source scale factors to be applied on a political jurisdiction basis. A scale factor in the form ±n.nn must be input for each pollutant - political jurisdiction combination. The order of input must be: SO_2-PJ#1, SO_2-PJ#2, ---, SO_2PJ#IJUR, Part-PJ#1, ----, Part-PJ#IJUR. If this card is input, all scale factors must be specified. If omitted, all scale factors assume the value 1.0.
ONI	IPRØJ - Projection flag for projecting ground level concentration to some future date. Set to one (1) for point source and individual area source projections, set to two (2) for point source and political jurisdiction wide area source projections. If omitted, or set to zero (0), projections will not be considered.
ONP	ASPRJ - Area source projection factors to be applied (to the scaled area sources) on a political jurisdiction basis. A scale factor in the form +nnnnnnn.nn must be input for each pollutant - political jurisdiction combination. The order of input is the same as in ASFAC. If omitted, all area source projection factors assume the value 1.0.
MN	&END - This variable signifies the end of NAMELIST inputs.

TABLE 7.9-1

PUNCHED CARD INPUTS FOR THE REGIONAL STRATEGIES PROGRAM (Continued)

Data Type	Description
MF	Strategy cards - one card is input for each political jurisdiction, in the order: PJ#1, PJ#2, ----, PJ#IJUR. Each card contains the following data:

Columns	Description	Format (Right Justified)
1-3	Pollutant number; 1 for SO_2, 2 for particulates	nnn
4-6	Political jurisdiction number	nnn
7-9	Fuel combustion standard number	nnn
10-12	Industrial process standard number	nnn
13-15	Solid waste standard number	nnn
20-40	Political jurisdiction name	alphanumeric-not right justified

Data Type	Description
MF	Strategy end card. Following the last strategy card, a card with END punched anywhere between columns 41 and 80 must be input.
OF	Area source scale factor cards - one card is input for each area source to be scaled. The factor input will be applied in place of the value given by ASFAC. If any scale factor cards are input, scale factor end card described next must also be input. Each scale factor card contains the following data:

Columns	Description	Format (Right Justified)
1-3	Region number	nnn
4-7	SIC number	nnnn
8-11	Site number	nnn

TABLE 7.9-1

PUNCHED CARD INPUTS FOR THE REGIONAL STRATEGIES PROGRAM (Continued)

Data Type	Description

Columns	Description	Format (Right Justified)
12	Process number	nn
13-17	SO_2 scale factor	+n.nn
18-22	Particulate scale factor	+n.nn

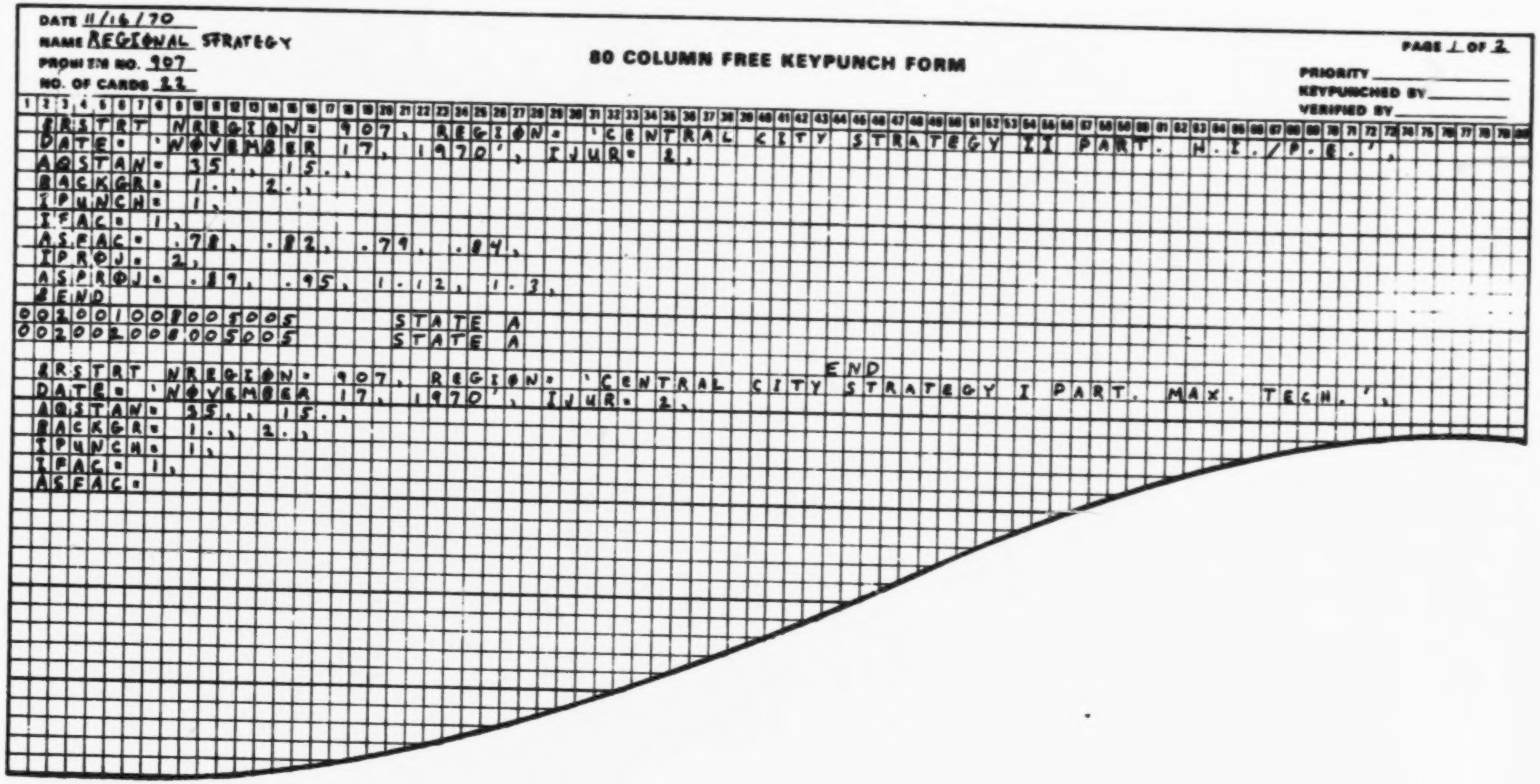
Data Type	Description
OF	Area source scale factor end card. Following the last scale factor card, a card with END punched anywhere between columns 41 and 80 must be input.
OF	Projection factor cards - one card is input for each source (point and area) for which a projection is desired. Point source projections are applied to allowable emission values and area source projections are applied to the scaled area source emission values. If any projection cards are input, the projection end card, described next, must be input after the projection cards. Each projection card contains the following data:

Columns	Description	Format (Right Justified)
1-3	Region number	nnn
4-7	SIC number	nnnn
8-10	Site number*	nnn
11-12	Process number*	nn
13-23	SO_2 projection factor	+nnnnnnn.nn
24-34	Particulate projection factor	+nnnnnnn.nn

Data Type	Description
OF	Projection end card - following the last projection card, a card with END punched anywhere between columns 41 and 80 must be input.

---

*For area sources, Site number is nnnn and Process number is n.



DATE 11/16/70
NAME REGIONAL STRATEGY
PROGRAM NO. 907
NO. OF CARDS 22

80 COLUMN FREE KEYPUNCH FORM

PAGE 1 OF 2
PRIORITY
KEYPUNCHED BY
VERIFIED BY

```
 &RSTRT  NREGION= 907, REGION= 'CENTRAL CITY STRATEGY II PART. H.I./P.E.',
 DATE=  'NOVEMBER 17,  1970', IJUR= 2,
 AQSTAN= 35., 15.,
 BACKGR= 1., 2.,
 IPUNCH= 1,
 IFAC= 1,
 ASFAC= .78, .82, .79, .84,
 IPROJ= 2,
 ASPROJ= .89, .95, 1.12, 1.3,
 &END
002001008005005      STATE A
002002008005005      STATE A

                                            END
 &RSTRT  NREGION= 907, REGION= 'CENTRAL CITY STRATEGY I PART. MAX. TECH.',
 DATE=  'NOVEMBER 17,  1970', IJUR= 2,
 AQSTAN= 35., 15.,
 BACKGR= 1., 2.,
 IPUNCH= 1,
 IFAC= 1,
 ASFAC=
```

Figure 7.9-3. Example Input Data Form for the Regional Strategies Program.

```
CENTRAL CITY STRATEGY II PARTICULATE H.I./P.E.

                 INPUT CONTROL STRATEGY

  POLLUTANT: PARTICULATES                        NOVEMBER 18, 1970

 ---------------------------------------------------------------------
 |                                                                   |
 |                                  _________EMISSION STANDARD_______|
 |             POLITICAL              FUEL       INDUSTRIAL     SOLID |
 |  ______JURISDICTION______       COMBUSTION   _PROCESS__     WASTE |
 |                                                                   |
 |  1  STATE A                          8            5            5  |
 |                                                                   |
 |  2  STATE B                          8            5            5  |
 ---------------------------------------------------------------------
```

Figure 7.9-4. Output Format - Input Control Strategy.

and the descriptive title of the strategy. The later two items are assigned by the user when developing and specifying the strategy. The pollutant being controlled and the date of the run are also presented in the table header. For each political jurisdiction the emission control standard applied to each source type is shown. The numeric identifications (from 1 to 26) refer to the emission standards described in Chapter 6.

Emission Standard Effects on Source Emissions (Figure 7.9-5)

The second type of printed output generated by the Control Strategies Program is shown in this figure. This tabulation is presented for each source type/political jurisdiction combination. A header indicating the regional identification, control strategy number and descriptive name, and date precedes each table. The source type, emission standard number and jurisdiction identification also are printed before the main tabular listing. The following items make up the column headings in this tabulation:

- Source Identification. Each source is identified by its SIC code, site and process numbers.
- Control Device. The device selected by the Emission Standards Program for this standard is identified by its numeric code (see Table 5-2). The computed annual cost and device efficiency are also shown.
- Required Efficiency. This decimal efficiency represents the degree of pollutant reduction required by the source to bring its potential emissions into compliance with the allowable emission defined by the control standard. If the source already has an existing control device then the required efficiency will be larger than that needed to bring the existing (partially controlled) emissions into compliance with the standard.
- Emissions. Three emission rates are displayed for each source: the existing emissions, the emissions allowable under the emission control standard, and the controlled emissions resulting from the application of the listed control device. The allowable emissions are utilized in the computation of air quality resulting from the application of the control strategy.

Jurisdictional Summary (Figure 7.9-6)

Following the presentation of the Emission Standard Effects on Source Emissions for each of the three source types within a political jurisdiction, a jurisdictional summary is printed. Again a table header is provided which identifies the control region and the emission control strategy under

```
                                                                              NOVEMBER 19, 1973
                      CENTRAL CITY STRATEGY II PARTICULATE H.I./P.E.

                              E M I S S I O N   S T A N D A R D   E F F E C T S   O N

                                        S O U R C E   E M I S S I O N S

                          INDUSTRIAL PROCESS STANDARD  5 FOR  PARTICULATE CONTROL
                                     STATE A                JURISDICTION
-----------------------------------------------------------------------------------------------------------
|  SIC   |SITE|PROC| DEVICE |    ANNUAL        |   DEVICE    |  REQUIRED   |     EMISSIONS (TONS/DAY)      |
|        |    |    |        |                  |             |             |-------------------------------|
|  CODE  |NO. |NO. |   ID   |  DEVICE COST     | EFFICIENCY  | EFFICIENCY  |EXISTING | ALLOWABLE|CONTROLLED|
|--------|----|----|--------|------------------|-------------|-------------|---------|----------|----------|
|  2119  |  1 | 25 | **  0  | $         0.0    |   0.0       |   0.0       |   0.10  |    0.10  |    0.10  |
|  2819  | 34 |  2 | **  0  | $         0.0    |   0.0       |   0.0       |   0.21  |    0.21  |    0.21  |
|  2819  |160 |  3 |     14 | $     52496.38   |   0.99000   |   0.96712   |  21.90  |    0.72  |    0.22  |
|  2951  |150 |  1 |      1 | $      7846.25   |   0.98000   |   0.92503   |   0.97  |    0.07  |    0.02  |
|  3241  |100 |  1 |G    10 | $    235426.44   |   0.94600   |   0.99000   |   2.79  |    1.49  |    0.15  |
|  3295  | 51 |  1 |     18 | $     41760.02   |   0.99000   |   0.98749   |  19.18  |    0.24  |    0.19  |
|  3332  |270 |  1 |      0 | $         0.0    |   0.0       |   0.97677   |   0.31  |    0.72  |    0.31  |
|__3332__|270_|__3_|______0_|_$_________0.0____|___0.0_______|___0.39585___|___0.22__|____0.21__|____0.22__|
              (*) INDICATES MOST EFFICIENT DEVICE WAS USED BUT ALLOWABLE WAS NOT ATTAINED.
              (**) INDICATES NO DEVICE AVAILABLE TO CONTROL THE SOURCE
              (G) INDICATES GAS COOLING WAS REQUIRED PRIOR TO DEVICE APPLICATION.
```

Figure 7.9-5. Output Format - Emission Standards Effects.

```
CENTRAL CITY STRATEGY II PARTICULATE M.I./P.E.                              NOVEMBER 18, 1970

                         J U R I S D I C T I O N   S U M M A R Y

                      STATE A              JURISDICTION

------------------------------------------------------------------------------------------------------------------------
| REGULATION TYPE      |    TOTAL      |    TOTAL      |EXISTING EMISSIONS|    EMISSION       |     ANNUAL      | CONTROL COST   |
|                      |  APPLICABLE   |  CONTROLLED   |       FOR        |    REDUCTION      |  CONTROL COST   |    PER TON     |
|  AND NUMBER          |POINT SOURCES  |POINT SOURCES  |  POINT SOURCES   |   (TONS/DAY)      |(MILLIONS OF $)  | REMOVED ($/TON)|
|                      |               |               |   (TONS/DAY)     |                   |                 |                |
|                      |               |               |                  |ALLOWED (CONTROLLED|                 |                |
|----------------------------------------------------------------------------------------------------------------------|
|     FUEL COMBUSTION  |       2       |       2       |        5.70      |  0.00       5.68  |      8.346      |     4045.63    |
|          8           |               |  *            |                  |                   |                 |                |
|                      |               |               |                  |                   |                 |                |
|   INDUSTRIAL PROCESS |       8       |       4       |       45.48      |  3.67      44.26  |      0.338      |       20.89    |
|          5           |               |G        **    |                  |                   |                 |                |
|                      |               |               |                  |                   |                 |                |
| SOLID WASTE DISPOSAL |       2       |       1       |        2.88      |  0.29       2.50  |      0.129      |      141.59    |
|          5           |               |         **    |                  |                   |                 |                |
|                      |               |               |                  |                   |                 |                |
|----------------------------------------------------------------------------------------------------------------------|
|  JURISDICTION TOTAL  |      12       |       7       |       54.06      |  3.96      52.44  |      8.853      |      462.53    |
------------------------------------------------------------------------------------------------------------------------
                               (*) SOME SOURCES COULD NOT ATTAIN THE ALLOWABLE EMISSION
                                  (**) NO DEVICE AVAILABLE  TO CONTROL SOME SOURCES.
                                  (G) GAS COOLING APPLIED TO SOME SOURCE(S).


    ----------J U R I S D I C T I O N  E M I S S I O N S------------      ---J U R I S D I C T I O N  F U E L  U S E

    EXISTING EMISSIONS (TONS/DAY)     CONTROLLED EMISSIONS (TONS/DAY)          COAL (TONS/DAY)..........       0.0

      POINT SOURCES....  54.1            POINT SOURCES....    1.6              RESID. OIL (GAL/DAY).....       0.0

      AREA SOURCES.....  16.1            AREA SOURCES.....   14.8              DIST. OIL (GAL/DAY)......       0.0
                        --------                            --------
                                                                               GAS (1000 CU. FT./DAY)... 41216336.000
      TOTAL EMISSIONS..   70.1           TOTAL EMISSIONS..   16.4                        .

    CONTROLLED REDUCTION..  53.7       PERCENTAGE REDUCTION... 76.6 %


                     J U R I S D I C T I O N   C O N T R O L   C O S T - E F F E C T I V E N E S S
                     ----------------------------------------------------------------------

          REDUCTION IN TOTAL POINT SOURCE EMISSION RATE . . . . . . . . . . . . . . . . .   462.53 DOLLARS/TON
```

Figure 7.9-6. Output Format - Jurisdiction Summary.

consideration. The run date and political jurisdiction are also displayed. The following data elements are included in the tabular presentation.

- Regulation Type and Number. The emission standard applied to each source type is identified by number.
- Total Applicable Point Sources. The number of point sources is listed both by source category and as a total for the jurisdiction.
- Total Controlled Point Sources. The number of sources required to reduce their pollutant emissions are tabulated in this column. Indicators are provided when certain of the sources cannot be properly controlled by the devices considered in the Control Cost Program.
- Existing Emissions for Point Sources. This column summarizes the existing pollutant emissions by source category.
- Emission Reduction. Two measures of emission reduction are included under this heading. Allowed emissions refer to the emission levels specified by the emission standards making up the control strategy. Controlled emissions indicate the amount of reduction produced by the control devices selected by the program to bring each source into compliance with the allowable emission levels. It must be noted that the two sets of figures in this column are not strictly comparable since the control device selected may produce a greater reduction than is required by the standard. Also, in some cases, there may be no control device available which allows a source to meet the emission level specified by the standard.
- Annual Control Cost. This column presents the accumulated control costs of the control devices assigned to each point source under the control strategy.
- Control Cost per Ton Removed. The figures presented in this column represent the product of the annual control cost divided by the number of tons of pollutant removed annually by the control device. These figures give an estimate of the cost effectiveness of control by source categories and overall effectiveness.

In addition to the main tabulation, described above, the Jurisdictional Summary also contains a summary of the emission pattern prior to and following the application of the control strategy. Both point and area source emissions are included in this summary. The reduction in area source emissions shown indicates the effect of the area source scale factors input by the user. The jurisdictional fuel use patterns following application of the control strategy are also displayed.

Control Strategy Summary (Figure 7.9-8)

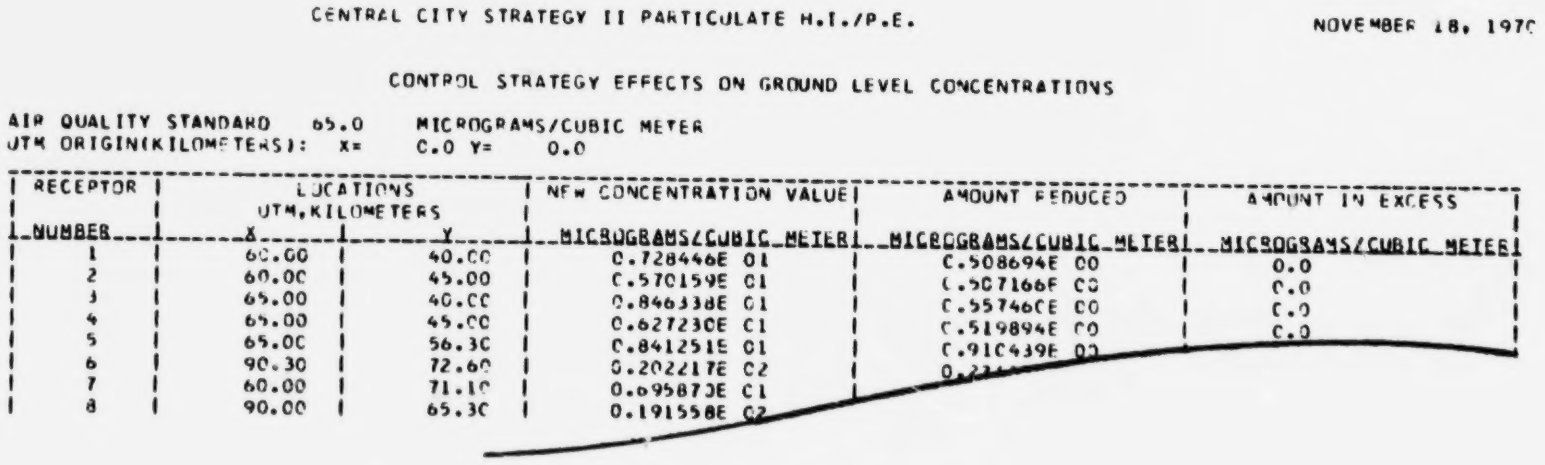
This figure provides an overall summary of the pollutant reductions required under the control strategy. The header information and column headings are the same as for the jurisdictional summaries described above. This tabulation represents the summation of control information over the entire air quality control region. One additional piece of information is included in this output which was not in the previous summaries. The reduction in ground level concentration indicates the number of dollars required to produce an average one microgram/cubic meter reduction in the regional pollutant levels. This value will vary between control strategies and thus provides another measure of effectiveness of each strategy.

Control Strategy Effects on Ground Level Concentrations (Figure 7.9-7)

The result of the pollutant emission reductions on ambient air quality throughout the region is displayed in this figure. The table header identifies the control region, control standard and the run date. The air quality standard for the pollutant being controlled is also shown. Each receptor location is identified with a unique number and by its X and Y coordinates. The expected pollutant concentration following the application of the control strategy is indicated in micrograms/cubic meter. The amount of reduction from the existing ambient conditions is also displayed in a separate column. The amount by which the concentration at each receptor point is in excess of the ambient air quality standard is also shown.

Projected Emission Inventory (Figure 7.9-9)

If the user inputs projection factors which relate existing emissions to those expected some time in the future, three additional outputs are generated by the Regional Strategies Program. This figure displays the adjusted pollutant emission rates for each point and area source identified in the region. Each source is identified by its nine digit identification and its political jurisdiction. Both the existing emission level and the emission level specified by the control strategy are adjusted by the input projection factor and are output.



```
CENTRAL CITY STRATEGY II PARTICULATE H.I./P.E.                                          NOVEMBER 18, 1970

                              CONTROL STRATEGY EFFECTS ON GROUND LEVEL CONCENTRATIONS

AIR QUALITY STANDARD    65.0    MICROGRAMS/CUBIC METER
UTM ORIGIN(KILOMETERS):  X=    0.0 Y=     0.0

-----------------------------------------------------------------------------------------------------------------------
| RECEPTOR |          LOCATIONS           | NEW CONCENTRATION VALUE|      AMOUNT REDUCED      |    AMOUNT IN EXCESS     |
|          |       UTM,KILOMETERS         |                        |                          |                         |
|_NUMBER___|_______X______|_______Y_______|__MICROGRAMS/CUBIC_METER|__MICROGRAMS/CUBIC_METER_|__MICROGRAMS/CUBIC_METER|
|     1    |     60.00    |      40.00    |     0.728446E 01       |      0.508694E 00        |     0.0                 |
|     2    |     60.00    |      45.00    |     0.570159E 01       |      0.507166E 00        |     0.0                 |
|     3    |     65.00    |      40.00    |     0.846338E 01       |      0.557460E 00        |     0.0                 |
|     4    |     65.00    |      45.00    |     0.627230E 01       |      0.519894E 00        |     0.0
|     5    |     65.00    |      56.30    |     0.841251E 01       |      0.910439E 00
|     6    |     90.30    |      72.60    |     0.202217E 02       |      0.22
|     7    |     60.00    |      71.10    |     0.695870E 01       |
|     8    |     90.00    |      65.30    |     0.191558E 02
```

Figure 7.9-7. Output Format - Ground Level Concentrations.

```
                    CENTRAL CITY STRATEGY II PARTICULATE M.I./P.E.                                  NOVEMBER 18, 1970
                                 C O N T R O L   S T R A T E G Y   S U M M A R Y

------------------------------------------------------------------------------------------------------------------------------------
|   JURISDICTION     |    TOTAL       |     TOTAL      |EXISTING EMISSIONS|      EMISSION       |     ANNUAL       |   CONTROL COST   |
|                    |  APPLICABLE    |  CONTROLLED    |       FOR        |      REDUCTION      |  CONTROL COST    |     PER TON      |
|    AND NUMBER      |POINT SOURCES   |POINT SOURCES   |  POINT SOURCES   |     (TONS/DAY)      |(MILLIONS OF $)   | REMOVED ($/TON)  |
|--------------------|----------------|----------------|---(TONS/DAY)-----|ALLOWED |CONTROLLED|                  |                  |
| STATE A            |       12       |        7       |       54.06      |  3.96      52.44   |      8.853       |      462.53      |
|         1          |                | *              |                  |                     |                  |                  |
| STATE B            |       14       |        8       |       28.20      |  6.16      25.37   |     16.364       |     1767.31      |
|         2          |                |                |                  |                     |                  |                  |
|--------------------|----------------|----------------|------------------|---------------------|------------------|------------------|
|  STRATEGY TOTAL    |       26       |       15       |       82.26      | 10.12      77.81   |     25.217       |      887.95      |
------------------------------------------------------------------------------------------------------------------------------------
                                              (*) SOME SOURCES COULD NOT ATTAIN THE ALLOWABLE EMISSION
                                                (**) NO DEVICE AVAILABLE  TO CONTROL SOME SOURCES.
                                                (G) GAS COOLING APPLIED TO SOME SOURCE(S).


       ----------------R E G I O N A L   E M I S S I O N S----------------        --------R E G I O N A L   F U E L   U S E----

       EXISTING EMISSIONS (TONS/DAY)     CONTROLLED EMISSIONS (TONS/DAY)            COAL (TONS/DAY)..........        0.0

         POINT SOURCES....  82.3           POINT SOURCES....    4.5                 RESID. OIL (GAL/DAY).....        0.0

         AREA SOURCES.....  20.1           AREA SOURCES.....   18.4                 DIST. OIL (GAL/DAY)......        0.0
                          ------                              -------
         TOTAL EMISSIONS..  102.3          TOTAL EMISSIONS..   22.8                 GAS (1000 CU. FT./DAY)...276613120.000

       CONTROLLED REDUCTION..  79.5       PERCENTAGE REDUCTION... 77.7 %


                          R E G I O N A L   C O N T R O L   C O S T - E F F E C T I V E N E S S
                          ---------------------------------------------------------------------

            REDUCTION IN TOTAL POINT SOURCE EMISSION RATE . . . . . . . . . . . .  887.95 DOLLARS/TON

            REDUCTION IN GROUND LEVEL CONCENTRATION . . .    25083840. DOLLARS/MICROGRAM/CUBIC METER
```

Figure 7.9-8. Output Format - Control Strategy Summary.

```
                    CENTRAL CITY STRATEGY II PARTICULATE H.I./P.E.

REGION: 907                                        DATE:NOVEMBER 18, 1970

                    PROJECTED EMISSION INVENTORY

SOURCE                            PROJECTED ALLOWABLE     PROJECTED EXISTING
__NO.__    SOURCE_ID      P.J.    ___EMISSION_RATE___    __EMISSION_RATE___
   1       2819 3420       1             0.00                  3.90
   2       4911  510       1             0.00                  1.80
   3       2119  125       1             0.10                  0.10
   4       2819 3402       1             0.0                   0.0
   5       281916003       1             0.72                 21.90
   6       295115001       1             0.07                  0.97
   7       324110001       1             1.39                  2.79
   8       3295 5101       1             0.24                 19.18
   9       333227001       1             0.72                  0.31
  10       333227003       1             0.21                  0.02
  11       495313001       1             0.25                  2.55
  12       495313102       1             0.04                  0.33
  13       2800 4110       2             0.00                  4.00
  14       3323 7130       2             0.00                  0.10
  15       3323 7140       2             0.00                  0.10
  16       4911  620       2             0.00                  4.20
  17       4911  730       2             0.00                  8.10
  18       2819 3302       2             0.52                  0.39
  19       287126001       2             0.58                  8.00
  20       2911 6101       2             0.43                  0.12
  21       331211101       2             3.33                  1.00
  22       331211102       2             1.06                  0.74
  23       331211103       2             0.18                  0.27
  24       3323 7201       2             0.13                  1.01
  25       495313104       2             0.08                  0.08
  26       495313202       2             0.03                  0.22
  27       9999  100       1             0.01                  0.01
  28       9999  200       1             0.02                  0.02
  29       9999  300       1             0.10                  0.10
  30       9999  400       1             0.12                  0.12
  31       9999  500       1             0.01
  32       9999  700       1             0.19
  33       9999  900       1             1.70
  34       9999 1000       1             1.06
  35       9999 1100       1             1.
  36       9999 1200       1
  37       9999 1300       1
  38       9999 1400       1
  39       9999 1500       1
  40       9999 1800       1
  41       9999 2000       1
  42       9999 2200       1
  43       9999 2500
  44       9999  600
  45       9999
  46       99
```

Figure 7.9-9 Output Format - Projected Emission Inventory.

Projected Emissions Summary (Figure 7.9-10)

This figure summarizes the result of the emission projection by political jurisdiction. Again both the existing emissions and allowable emissions are projected.

Projections for Emission Standard Effects on Ground Level Concentrations (Figure 7.9-11)

The ground level pollutant concentrations based on the projected allowable emissions are presented as shown in this figure. The tabulated quantities are identical to those described for a standard, non-projected, control strategy run (see Figure 7.9-8).

```
                       CENTRAL CITY STRATEGY II PARTICULATE M.I./P.R.

REGION: 907                                     DATE:NOVEMBER 18, 1970

                     PROJECTED EMISSION SUMMARY

  POLITICAL      TOTAL PROJECTED ALLOWABLE    TOTAL PROJECTED EXISTING
JURISDICTION     ------EMISSION RATE------    ------EMISSION RATE------
      1                   18.56                         69.91
      2                    9.89                         32.13
```

Figure 7.9-10. Output Format - Projected Emission Summary.

```
                   CENTRAL CITY STRATEGY II PARTICULATE H.I./P.E.                                 NOVEMBER 18, 1970

                                                   PROJECTION FOR

                                  CONTROL STRATEGY EFFECTS ON GROUND LEVEL CONCENTRATIONS

AIR QUALITY STANDARD   65.0    MICROGRAMS/CUBIC METER
UTM ORIGIN(KILOMETERS):  X=    0.0 Y=    0.0
------------------------------------------------------------------------------------------------------------------------
| RECEPTOR |            LOCATIONS          | NEW CONCENTRATION VALUE|      AMOUNT REDUCED       |    AMOUNT IN EXCESS      |
|          |        UTM,KILOMETERS         |                        |                           |                          |
|_NUMBER___|_______X_______|_______Y_______|_MICROGRAMS/CUBIC_METER_|_MICROGRAMS/CUBIC_METER_|_MICROGRAMS/CUBIC_METER|
|     1    |     60.00     |     40.00     |     0.728309E 01       |     0.504207E 00          |    0.0                   |
|     2    |     60.00     |     45.00     |     0.569985E 01       |     0.500709E 00          |    0.0                   |
|     3    |     65.00     |     40.00     |     0.846199E 01       |     0.552670E 00          |    0.0                   |
|     4    |     65.00     |     45.00     |     0.627051E 01       |     0.512144E 00          |    0.0                   |
|     5    |     65.00     |     56.30     |     0.840918E 01       |     0.883983E 00          |
|     6    |     90.30     |     72.60     |     0.202143E 02       |     0.236643E 01
|     7    |     60.00     |     71.10     |     0.695377E 01       |     0.649113E
|     8    |     90.00     |     65.30     |     0.191402E 02       |     0.20
```

Figure 7.9-11. Output Format - Projected Ground Level Concentrations.

8.0 PROGRAM MESSAGES

8.1 PURPOSE

Under certain circumstances, the Implementation Planning Program prints special messages to the user which provide error diagnostics, advisory warnings or general information. The message contents, the circumstances for their occurrence and the accompanying program actions have previously been described in Chapters 3 through 7 of this volume. However, for the convenience of the user, all the information is summarized here.

In addition to special program messages printed by the Implementation Planning Program, the operating system employed at the user's computing facility may, under certain conditions, also print coded diagnostic messages. For an explanation of these, the user is referred to the standard FORTRAN and COBOL manuals available at the facility; or he may seek the advice of the resident systems programmers.

8.2 SOURCE DATA MANAGEMENT PROGRAM - ERROR MESSAGES

There are a number of possible format errors that the user can fall victim to when providing punched card inputs to the Source Data Management Program. The actual edit error list printed by the program may contain any number of errors, depending on the number of input cards that failed to pass the editing sequence. The message formats are all of the form:

FMXX SOURCE X(12) FIELDXX Field Content, Message Content

The manual reference number is printed first, then the word "SOURCE" followed by the 12 digit source identification, then the word "FIELD" followed by a two digit identification of the particular field of the record found in error, then the actual field content as input by the user, and last, the error message content. Table 8-1 lists each message code, along with the message and an explanation.

There are three basic transactions conducted by the Source Data Management Program: create or add, delete, and change. Some of the error messages listed in Table 8-1 pertain to all three of these transactions, whereas some pertain to only one transaction type. The transactions to which these messages apply are evident from the explanation provided in the table.

TABLE 8-1

SOURCE FILE MAINTENANCE DIAGNOSTICS

Manual Reference Number	Message Content	Message Significance
FM01	"BLANK FIELD"	A mandatory nonblank field is blank.
FM02	"NOT NUMERIC"	A numeric field has been input with non-numeric character(s). (Possibly an illegal character or embedded blanks.)
FM03	"BOTH FIELDS BLANK"	One field may be blank, but not both.
FM04	"BAD I.D. FIELD"	The identification field of a source transaction is non-numeric.
FM05	"TRANS OUT OF SORT"	The source transaction file has not been sorted at all, or has been sorted improperly.
FM06	"DUPLICATE SOURCE TRANSACTION"	A duplicate source transaction has been encountered. Program will skip this transaction and continue with the next.
FM07	"INVALID SOURCE TYPE"	The Source Type must be either B, P, or S.
FM08	"INVALID OWNERSHIP"	Ownership must be either P, L, S, F, or U.
FM09	"NO NAME"	The descriptive name can never be blank.
FM10	"NO CARD NUMBER"	The card number is missing on a point source input. This field is blank for area sources only.
FM11	"NO TRANSACTIONS"	No transaction records can be found on the input deck (User has failed to provide update cards to program.)
FM12	"NO ACTION CARD"	The action card is not the first card input. Either the deck is not sorted properly or the card is not present at all.
FM13	"NO DATE RECORD"	The date record is not the first record on the old Source File.

TABLE 8-1

SOURCE FILE MAINTENANCE DIAGNOSTICS (Continued)

Manual Reference Number	Message Content	Message Significance
FM14	"RECORD NOT ON FILE"	The record requested for updating is not present on the old Source File.
FM15	"NO SOURCE INPUT"	The old Source File does not contain any source records, only the data record is present.
FM16	"NO SOURCE TRANSACTIONS"	The Source Transaction File contains only the action record and no data.
FM17	"NO DUMMY RECORD"	This error occurs if an update is attempted for an incomplete file. The file must be recreated.
FM18	"AREA SOURCE ALREADY EXISTS"	Transaction seeks to add source that already exists on file. Must request a change or delete.
FM19	"NO TRANSACTION CODE"	Either a D, C, or A must be present in card column 79 of the transaction.
FM20	"NO CARD 1"	On a create or add transaction, cards 1 and 3 must be present or the source will not be entered on the file.
FM21	"NO CARD 3"	On a create or add transaction, cards 1 and 3 must be present or the source will not be entered on the file.
FM22	"WRONG REGION NUMBER ON ACTION CARD"	During an update transaction, if a region number is found on an action card that does not correspond to the region number on the file, then the program terminates.

An error encountered during the editing sequence of any transaction will prevent the entry (or deletion) of the entire record for that source. If more than one input card is involved in creation of the record, and if an error is encountered on the first card, the program will edit the other cards for that source before going on to the next record. All the point and area source input cards to the Source File are numbered according to the scheme described in Section 7.2.3.

8.3 AIR POLLUTANT CONCENTRATION PROGRAM - DIAGNOSTIC MESSAGES

The calibration procedure in the Air Pollutant Concentration Program can give rise to one of the first two diagnostic messages (A1, A2 in Table 8-2. These messages merely explain the calibration action taken by the program. The message is printed as shown under the Message Content column; the Manual Reference Number is not output.

In addition, the program may print one of three (AC01, AC02, AC03) error messages prior to an abnormal termination. These messages indicate errors detected in the inputs (Source File or card inputs) that will cause the program to fail sooner or later. These diagnostic messages all have the following format:

ACXX-Message Content,

where ACXX is the manual reference number.

8.4 SOURCE CONTRIBUTION FILE MERGE PROGRAM

The Source Contribution File Merge Program does not print any special messages. However, if a bad input tape is encountered, a system diagnostic will be obtained.

8.5 THE CONTROL COST PROGRAM - DIAGNOSTIC MESSAGES

A variety of diagnostic messages are produced in the Control Cost Program. These may originate with source file data or user supplied card inputs. The program does not perform an edit sequence as such and all special messages result from the failure of consistency checks undertaken in the course of the calculation. Unless otherwise noted in Table 8-3, these errors do not result in an abnormal termination. The program continues to process a given device until an error is encountered, at which point no further processing is done for the device and the program

TABLE 8-2

AIR POLLUTANT CONCENTRATION PROGRAM MESSAGES

Manual Reference Number	Message Content	Message Significance
A1	NOT STATISTICALLY SIGNIFICANT	The theoretical value (5 percent confidence level) expected for the correlation coefficient is shown. If the calculated correlation coefficient is less than or equal to the 5 percent value, the following note is printed in the output table; "NOT STATISTICALLY SIGNIFICANT." When this occurs, the air quality values at receptors will be printed without the use of these regression constants. It should also be noted that in this case the constants should not be input using the SO2CAL= and PARCAL= cards (Section 7.3.3); instead, the reason for the poor correlation should be determined and the necessary corrections made.
A2	STATISTICALLY SIGNIFICANT	This is the opposite circumstance to A1 above. In this case, the calculated coefficient is greater than the 5 percent confidence level.
AC01	DPTMX, WNDFREQ, TA, PA MUST BE ALL NON-ZERO--RUN TERMINATED	The user must input non-zero values for the mixing height, wind frequency, ambient temperature and ambient pressure.
AC02	IREG NOT EQUAL TO 0, 1, OR 2--RUN TERMINATED	IREG contains an invalid input that will cause the program to dump.
AC03	IMPROPER RECEPTOR INPUT--RUN TERMINATED	Both the grid system and the non-grid receptors were not included in the card inputs to the program.

TABLE 8-3

CONTROL COST PROGRAM DIAGNOSTIC MESSAGES

Manual Reference Number	Message Content	Message Explanation
CM01	ERROR IN SO_2 OR PART-EMISSION RATE SOURCE ID XXXXXXXXXXXX EMISSION FACTOR INPUT EMISSION SO_2 XXXX.XXX XXXX.XXX PART XXXX.XXX XXXX.XXX	The emission factors (i.e., calculated emission rates) are calculated by the following equations: SO_2: $E_s = (E_{sc} + E_{sr} + E_{sd} + E_{sg})(1-D_s)$ PART: $E_p = (E_{pc} + E_{pr} + E_{pd} + E_{pg})(1-D_p)$ The diagnostic message occurs when either or both of the inequalities shown below are not satisfied: $0.8\ e_s \leq E_s \leq 1.2\ e_s;\ 0.8\ e_p \leq E_p \leq 1.2\ e_p$, where e_s is the input SO_2 emission rate and e_p is the input particulate emission rate. The error must be corrected by changing the appropriate source file data.
CM02	NO FUEL SUBSTITUTES AVAILABLE FOR SOURCE ID XXXXXXXXXXXX	This message indicates that for a fuel elimination measure there were no fuels that had a sulfur content less than or equal to the sulfur content of the fuel already burned by the source, or the cost of the fuel to be substituted was input as zero. This error occurs on fuel elimination (measures 27, 28, and 29) only. Processing continues with the next device (30) that is not a fuel elimination. The problems may have orignated with sulfur content values in the Source File or regional NAMELIST data, or the cost data in the regional NAMELIST set.

TABLE 8-3

CONTROL COST PROGRAM DIAGNOSTIC MESSAGES (Continued)

Manual Reference Number	Message Content	Message Explanation
CM03	CONTROL EFFICIENCY OF SO_2 SHOULD NOT BE 1 FOR SOURCE ID XXXXXXXXXXXX CONTROL EFF. = X.XX	This error indicates that the control efficiency for SO_2 was input as 1.00 for the source shown. This error can be corrected by updating the source file.
CM04	CONTROL EFFICIENCY OF PART. SHOULD NOT BE 1 FOR SOURCE ID XXXXXXXXXXXX CONTROL EFF. = X.XX	Same as CM03 except the control efficiency is for particulate.
CM05	SO_2 AND PART. EMISSION ARE BOTH ZERO FOR SOURCE ID XXXXXXXXXXXX	This message indicates both SO_2 and particulate emissions were input as zero. This error can be corrected by changing the Source File.
CM06	EXIT TEMPERATURE SHOULD NOT BE ZERO FOR SOURCE ID XXXXXXXXXXXX	This message indicates that value input for the temperature (°F) resulted in a value of zero, after internal conversion. The problem must be corrected by updating the Source File.
CM07	EXHAUST VOLUME SHOULD NOT BE ZERO FOR SOURCE ID XXXXXXXXXXXX	The exhaust volume was input as zero in the source file and must be corrected by updating the Source File.
CM08	RATED CAPACITY SHOULD NOT BE ZERO FOR SOURCE ID XXXXXXXXXXXX	The rated capacity for a combustion source was input as zero. This error can be corrected by updating the source file.
CM09	THE SIC AND PROCESS CODE XXXX XX ARE NOT IN THE DEVICE APPLICABILITY TABLE	This message indicates that the current source has a SIC and process code that is not in the device applicability table. The error could be caused by an incorrect SIC or process code in the source file, the device applicability table, or the NAMELIST inputs to the device applicability table.

continues to the next device. The diagnostic messages in Table 8-3 are all of the following format:

```
CMXX - Message content,
```

where the first expression is the manual reference number. The message content identifies the source by the region number, the SIC code, site number and process code:

```
SOURCE ID   XXX    XXXX XXX   XX*
                 Region SIC Site Process
```

8.6 THE CONTROL COST FILE UPDATE PROGRAM - ERROR MESSAGES

The Control Cost File Update Program provides the following three line error messages:

```
****** ERROR ****** RECORD FOR SOURCE.
XXXXXXXXX DEVICE XXX COULD NOT BE UPDATED.         |line one
EITHER RECORD IS NOT ON FILE                       |line two
OR UPDATE CARD WAS OUT OF ORDER.
SUCCEEDING UPDATES WERE ALSO IGNORED.              |line three
```

The message provides the source and device identification. The device identification is according to Table 5-1 and the source is identified according to SIC code, site number and process code:

```
SOURCE   XXXX    XXX    XX
          SIC    Site   Process
```

The message is self-explanatory.

8.7 THE EMISSION STANDARDS PROGRAM - DIAGNOSTIC MESSAGE

The diagnostic messages produced by the Emission Standards Program are all listed in Table 8-4. Each message is in the form of a printed text that supplies the manual reference number, identifies the data element producing the difficulty, describes the nature of the difficulty and the program action (if any).

The first two messages listed in Table 8-4 are edit error messages for the input cards. The remaining messages relate to data difficulties (Control Cost File or card inputs) encountered during the program execution.

---

*The data field of the printed diagnostic contains no blanks.

TABLE 8-4

EMISSION STANDARDS PROGRAM ERROR MESSAGES

MESSAGE TEXT

INP01 - POLITICAL JURISDICTION NO. XX NOT IN ORDER - RUN TERMINATED AT COMPLETION OF POLITICAL JURISDICTION NO. XX.

INP02 - SOURCE XXXXXXXXX EXISTING DEVICE EFFICIENCY FOR POLLUTANT X IS 100% OR GREATER.

**EST05A - SOURCE XXXXXXXXX PE VALUE OF XXXXX.XX. EXCEEDS TABLE LIMIT, STANDARD CANNOT BE APPLIED.

**EST05B - SOURCE XXXXXXXXX PE VALUE OF XXXXX.XX. LESS THAN MINIMUM TABLE VALUE, ALLOWABLE SET EQUAL TO EXISTING EMISSIONS.

**EST06A - SOURCE XXXXXXXXX PE VALUE OF XXXXXXX. EXCEEDS TABLE LIMIT, STANDARD CANNOT BE APPLIED.

**EST06B - SOURCE XXXXXXXXX PE VALUE OF XXXXX.XX. LESS THAN MINIMUM TABLE VALUE, ALLOWABLE SET EQUAL TO EXISTING EMISSIONS.

**EST07A - SOURCE XXXXXXXXX PE VALUE OF XXXXXX. EXCEEDS TABLE LIMIT, STANDARD CANNOT BE APPLIED.

**EST07B - SOURCE XXXXXXXXX PE VALUE OF XXXXX.XX. LESS THAN MINIMUM TABLE VALUE, ALLOWABLE SET EQUAL TO EXISTING EMISSIONS.

**EST08A - SOURCE XXXXXXXXX HI VALUE OF XXXXXXX. EXCEEDS TABLE LIMIT, STANDARD CANNOT BE APPLIED.

**EST08B - SOURCE XXXXXXXXX HI VALUE OF XXXXX.XX. LESS THAN MINIMUM TABLE VALUE, ALLOWABLE SET EQUAL TO EXISTING EMISSIONS.

**EST09A - SOURCE XXXXXXXXX HI VALUE OF XXXXXXX. EXCEEDS TABLE LIMIT, STANDARD CANNOT BE APPLIED.

**EST09B - SOURCE XXXXXXXXX HI VALUE OF XXXXX.XX. LESS THAN MINIMUM TABLE VALUE, ALLOWABLE SET EQUAL TO EXISTING EMISSIONS.

**EST10A - SOURCE XXXXXXXXX HI VALUE OF XXXXXXXXX. EXCEEDS TABLE LIMIT, STANDARD CANNOT BE APPLIED.

**EST10B - SOURCE XXXXXXXXX HI VALUE OF XXXXX.XX. LESS THAN MINIMUM TABLE VALUE, ALLOWABLE SET EQUAL TO EXISTING EMISSIONS.

**EST11A - SOURCE XXXXXXXXX PHYSICAL STACK HEIGHT IS LESS THAN MINIMUM CURVE VALUE - STANDARD CANNOT BE APPLIED.

**EST11B - SOURCE XXXXXXXXX PHYSICAL STACK HEIGHT EXCEEDS MAXIMUM CURVE VALUE - STANDARD CANNOT BE APPLIED.

TABLE 8-4

EMISSION STANDARDS PROGRAM ERROR MESSAGES (Continued)

MESSAGE TEXT

**EST11C - SOURCE XXXXXXXXX HI VALUE OF XXXXXXXXX. EXCEEDS TABLE LIMIT, STANDARD CANNOT BE APPLIED.

**EST11D - SOURCE XXXXXXXXX HI VALUE OF XXXXX.XX. LESS THAN MINIMUM TABLE VALUE, ALLOWABLE SET EQUAL TO EXISTING EMISSIONS.

**EST12A - SOURCE XXXXXXXXX EFF. STACK HEIGHT OF XXXXXXX. EXCEEDS TABLE LIMIT - STANDARD CANNOT BE APPLIED.

**EST12B - SOURCE XXXXXXXXX EFF. STACK HEIGHT OF XXX.XX LESS THAN MINIMUM TABLE VALUE, ALLOWABLE SET = EXISTING EMISSION.

**EST18A - SOURCE XXXXXXXXX PROCESS WEIGHT XXXXXXXXX. EXCEEDS TABLE LIMIT - STANDARD CANNOT BE APPLIED.

**EST18B - SOURCE XXXXXXXXX PROCESS WEIGHT XXX.XX LESS THAN MINIMUM TABLE VALUE - ALLOWABLE SET = EXISTING EMISSION.

**EST19A - SOURCE XXXXXXXXX PROCESS WEIGHT XXXXXXXXX. EXCEEDS TABLE LIMIT - STANDARD CANNOT BE APPLIED.

**EST19B - SOURCE XXXXXX PROCESS WEIGHT XXX.XX LESS THAN MINIMUM TABLE VALUE - ALLOWABLE SET = EXISTING EMISSION.

**EST20A - SOURCE XXXXXXXXX PROCESS WEIGHT XXXXXXXXX. EXCEEDS TABLE LIMIT - STANDARD CANNOT BE APPLIED.

**EST20B - SOURCE XXXXXXXXX PROCESS WEIGHT XXX.XX LESS THAN MINIMUM TABLE VALUE - ALLOWABLE SET = EXISTING EMISSION.

The source is identified by SIC code, site number and process code as follows:

```
SOURCE XXXX XXX    XX
       SIC  Site   Process
```

In the case of message INP02, the program bypasses the source entirely and goes on to the next source. To correct this difficulty the Cost File must be modified or recreated. All the error messages following INP02 in the table arise during the application of emission standards to the sources. In these cases, the program sets the error flag (0, 1 or 2 as explained in Section 7.7.4) and goes on to the next emission standard. Any additional program actions are noted in the diagnostic message.

8.8 EMISSION STANDARDS FILE UPDATE PROGRAM - ERROR MESSAGES

The Emission Standards File Update Program has the capability of changing, deleting or adding records to the Emission Standards File. In the course of the editing sequence, the program may print any of the following five message types:

ESFU01 13(X) ATTEMPTING ILLEGAL UPDATE

- This message indicates that the user has called for an update (change or delete) or a record that is not present on the file. If the update calls for the addition of a new record, however, then the transaction is legal and the message is not printed.

ESFU02 13(X) NON-NUMERIC FIELD IN UPDATE CARD

- This message indicates that the user has attempted to add a record to the file that contains non-numeric data.

ESFU03 13(X) ATTEMPTING ILLEGAL UPDATE

- This message indicates that the user has attempted to update (change or delete) an existing record on the file with a code that is not a 'D' or 'C'.

ESFU04 13(X) NO UPDATE ACTION TAKEN - CARD HAS NON-NUMERIC FIELD

- This message is caused by an attempt to change an existing data field with a non-numeric input card.

ESFU05 13(X) UNCORRECTED ERROR ON UPDATED FILE

- This message indicates that the user has not provided input cards to update a record which has an error flag set.

All of the above messages contain the manual reference number and thirteen character identification fields. The identification field (13(X)) contains the following information:

1) political jurisdiction - 2 characters
2) category - 1 character
3) pollutant number - 1 character
4) SIC code - 4 characters
5) Site number - 3 characters
6) Standard number - 2 characters

The first four messages occur during the edit sequence. In all of these cases, the program will not perform any update transactions for a record which has even a single incorrect update card. The program proceeds to the next record for which update cards have been provided. The last message can only occur at the end of the edit sequence. The program performs a search of the file to check if all identified (flagged) errors have been provided with updates.

8.9 REGIONAL STRATEGIES PROGRAM - DIAGNOSTIC MESSAGES

The Regional Strategies Program can print any of five diagnostic messages. These all relate to problems with reading in data and all result in a premature termination of the run. These messages are as follows:

```
**RST01 - STRATEGY DATA MISSING - RUN TERMINATED
```

- This message indicates that either a wrong value for the political jurisdiction was included in the NAMELIST data or an incorrect number of strategy cards (Section 7.9.2) were input. The run was terminated without output except for printout of the input data successfully read by the program.

```
**RST02 - ERROR READING APC SOURCE CONTRIBUTION
          DATA - NO AIR QUALITY OUTPUT
```

- This message indicates that that the program could not read past the first record of the Source Contribution File produced by the Air Pollutant Concentration Program. Consequently, the run was terminated without any air quality output.

***RST03 - ERROR READING APC SOURCE CONTRIBUTION
DATA - AIR QUALITY OUTPUT TERMINATED

- This message indicates that difficulty was encountered in reading some record (not the first) of the Source Contribution File. Consequently, the run was terminated without any air quality output.

**RST04 - NO END CARD. PROJECTION REPORTS TERMINATED

- This message indicates that either more than 2000 projection factor cards (Section 7.9.2) were input or the end card was omitted. The run was terminated without any projection output.

**RST05 - AREA SOURCE SCALE DATA MISSING - RUN
TERMINATED

- This message indicates that either the last scale data card was absent or some other part of the scale data was missing, or both. The run was terminated without any output, except for the printed summary of the input data successfully read by the program.

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9.0 COMPUTER REQUIREMENTS

9.1 PURPOSE

A computer program is of no use until it is properly installed on a computer. This chapter, which presents the minimum computer configuration required, and Chapter 7, which provides detailed program operating instructions, will prepare the user to install and operate the Implementation Planning Program. After installation, the user should then conduct a special test run employing the detailed data forms and descriptions of the inputs and outputs for the sample case (Installation Test Case) given in Volume II to verify the program operation. Once these outputs are successfully duplicated, the program is ready to be used as a tool in regional air pollution analysis.

Since this chapter provides the user with only the basic computer requirements, including storage and run time, he is urged to consult with systems programmers assigned to the computer facility at which the Implementation Planning Program is to be installed. The programmers are in the best position to determine the adequacy of the available hardware and software.

9.2 GENERAL COMPUTER REQUIREMENTS

The design of the individual computer programs is predicated upon the availability of a computer hardware and software configuration possessing the following (minimum) characteristics:

- IBM 360 Model 40
  Central processing unit with at least 256,000 bytes of core storage (56,000 bytes for system).
- An IBM 2314 disk module.
- Two IBM 2401 Mod. II magnetic tape units.
- A card reader/punch and high-speed line printer.
- The full OS (version 17 or later), capable of supporting the above hardware configuration.
- Software support of FORTRAN G and COBOL F compilers.

In both the preparation of the disk file and the execution of the program, the IBM System 360 Job Control Language (JCL) is used [IBM, 1969]. The language provides the user with a means of influencing the scheduling of computing operations and the allocation of computing resources.

9.3 EXECUTION TIME

The execution time estimates given below for each of the Implementation Planning Program job steps are noted in terms of central processor time on an IBM 360/40, and unless otherwise stated, are for the particular example provided by the Installation Test Case (Volume II).

Creation of the Source File by the Source Data Management System takes place in several short steps; a typical file takes approximately 5 minutes to create and the Installation Test requires only 3.2 minutes.

The Air Pollutant Concentration Program takes about 20 minutes to process 55 sources and output pollutant concentration for 36 receptors.

The Control Cost Program requires about 3 minutes for 26 sources and 34 devices. Running time for this program is directly proportional to the number of point sources in the Source File.

The Emission Standards Program (ESTAND) requires 1.1 minutes to process 26 point sources through 16 emission standards. Running time is directly proportional to the number of point sources and emission standards.

The Regional Strategies Program (RSTRAT) takes approximately 1.38 minutes for 2 strategies covering 55 sources, 2 political jurisdictions, and 6 emission standards each.

The Source Contribution File Merge Program takes approximately 2-3 minutes to process a pair of sub-region files.

9.4 CORE REQUIREMENTS

The core memory requirements for each of the models are listed in Table 9-1.

The Input/Output Buffer requirements (Item 9) in Table 9-1 should be added to the values shown for the Air Pollutant Concentration Program the Control Cost Program, the Emission Standards Program and the Control Strategies Program.

TABLE 9-1

IMPLEMENTATION PLANNING PROGRAM CORE REQUIREMENTS

	Program	Core Memory (Bytes)
1.	Source Data Management Program	50,000
2.	Air Pollutant Concentration Program	100,000 (for largest segment when program is overlayed, otherwise more than 150,000 required)
3.	Source Contribution File Merge Program	53,000
4.	Control Cost Program	100,000 (for largest segment when program is overlayed, otherwise more than 130,000 required)
5.	Control Cost File Update Program	22,000
6.	Emission Standards Program	75,000 (for largest segment when program is overlayed, otherwise more than 100,000 required.
7.	Emission Standards File Update	35,000
8.	Region Strategies Program	58,000 (for largest segment when program is overlayed otherwise about 100,000 required)
9	Input/Output Buffers	10,000 - 15,000

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10.0 REFERENCES

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    DA TM-5-241-4/2 "Transformation of Coordinates from Grid to Geographic," Vol. II, July 1958.

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APPENDIX A

FEDERAL LEGISLATION

1. BACKGROUND

1955

The U. S. Congress first responded to growing public concern over declining air quality in July 1955, with legislation authorizing a Federal program of air pollution research and technical assistance to State and local governments (PL 84-159). This legislation established a policy, retained in all subsequent legislation, that State and local governments have fundamental responsibility for local air pollution control with the Federal Government providing leadership and support.

1959

In 1959, Congress amended PL 84-159, declaring that Federal departments and agencies should cooperate with the Department of Health, Education and Welfare and with interstate, State, and local air pollution control agencies in the control of pollutants contributed to the atmosphere of a given region from facilities under Federal jurisdiction.

1961

The first congressional efforts to bring motor-vehicle emissions under control resulted in PL 86-493. This legislation authorized the Public Health Service to conduct a study of pollution caused by motor vehicles and to report the results to Congress. An amendment to this statute (PL 87-761), passed in 1961, authorized motor-vehicle pollution studies on a continuing basis.

1963

As a result of this early legislation, significant progress was made toward achieving an understanding of the air pollution problem and developing methods for air pollution control. By 1963, however, it became obvious that this progress in scientific understanding was not being translated into improved air quality, primarily because State and local governments had neither the resources nor the authority to adequately cope with the problem.

To accelerate air pollution control activities, Congress passed the "Clean Air Act" of 1963 (PL 88-206). This legislation dramatically altered the thrust of the Federal approach to air pollution control. The Act authorized two major new programs: the awarding of grants directly to State and local agencies to assist them in developing, establishing, or improving control programs; and the initiation of Federal abatement actions to cope with interstate and, in some cases, intrastate pollution problems. In addition, it demanded accelerated research, training, and technical assistance activities, and called for the development of criteria on the effects of air pollution on health and property.

As a result of the Clean Air Act, State and local control programs underwent considerable expansion. Federal control actions were initiated, resulting in cleaner air for many communities, and research efforts were expanded.

1965

Various studies had indicated that motor vehicles were contributing significantly to overall air pollution levels, and in 1965 Congress passed an amendment to the Clean Air Act authorizing the Department of Health, Education and Welfare to set emission standards for motor vehicles.

1966

In 1966, another amendment to the Clean Air Act (PL 89-675) authorized grants to State and local air pollution control agencies to assist them in maintaining their programs. These grants supplemented the previously authorized assistance for establishing, developing, and improving programs.

1967

In spite of all of this legislation, the magnitude of the growing air pollution problem rendered control activities inadequate. This inadequacy led to the adoption of new legislation (PL 90-148) which provides a blueprint for a systematic effort to deal with air pollution problems on a regional basis.

The Clean Air Act as amended calls for coordinated action at all levels of government and among all segments of industry. The system which it develops hinges on the designation of air quality control regions. These regions are to be set up according to meteorological and other technical factors, as well as social and political factors, so that areas which share a common air pollution problem may exercise a coordinated control activity. These regions are designated by the Department of Health, Education and Welfare, which is also responsible for monitoring each region's progress in the development and implementation of air quality standards. Other major provisions of the Act as amended include: expansion of the Federal Government's air pollution research and development activities; continuation of grants to States and communities to assist them in their efforts to control air pollution; continued efforts to control pollution at Federal installations; and investigation of manpower and training needs in the air pollution field.

2. CLEAN AIR ACT AS AMENDED

The Clean Air Act as amended provides for the establishment of an intergovernmental system for the prevention and control of air pollution on a regional basis. To put this system into operation, the Department of Health, Education and Welfare must designate air quality control regions and issue air quality criteria and reports on control techniques. State governments are then expected to establish air quality standards for the air quality control regions and to adopt plans for implementation of these standards. The air quality standards and implementation plans prepared by the states must be submitted to HEW for review [Guidelines, 1969].

Figure A-1 shows the division of responsibilities under the Clean Air Act as amended. In developing the Air Quality Display Model [TRW, 1969] and the Implementation Planning Program described in this report, TRW has been guided by the operational structure specified in this legislation. Particular attention has been directed toward the following key elements:

(a) Air Quality Control Regions. Air Quality Control Regions represent the local, operational level for air pollution control as envisioned in the Clean Air Act as amended. Region boundaries are defined on the basis of an analysis of social and political factors as well as physical air pollution effects, and thus may not coincide with established political or geographic divisions. The borders of a given air quality control region will be established so as to include the principal emitters or sources of pollutants for the area, together with a majority of the

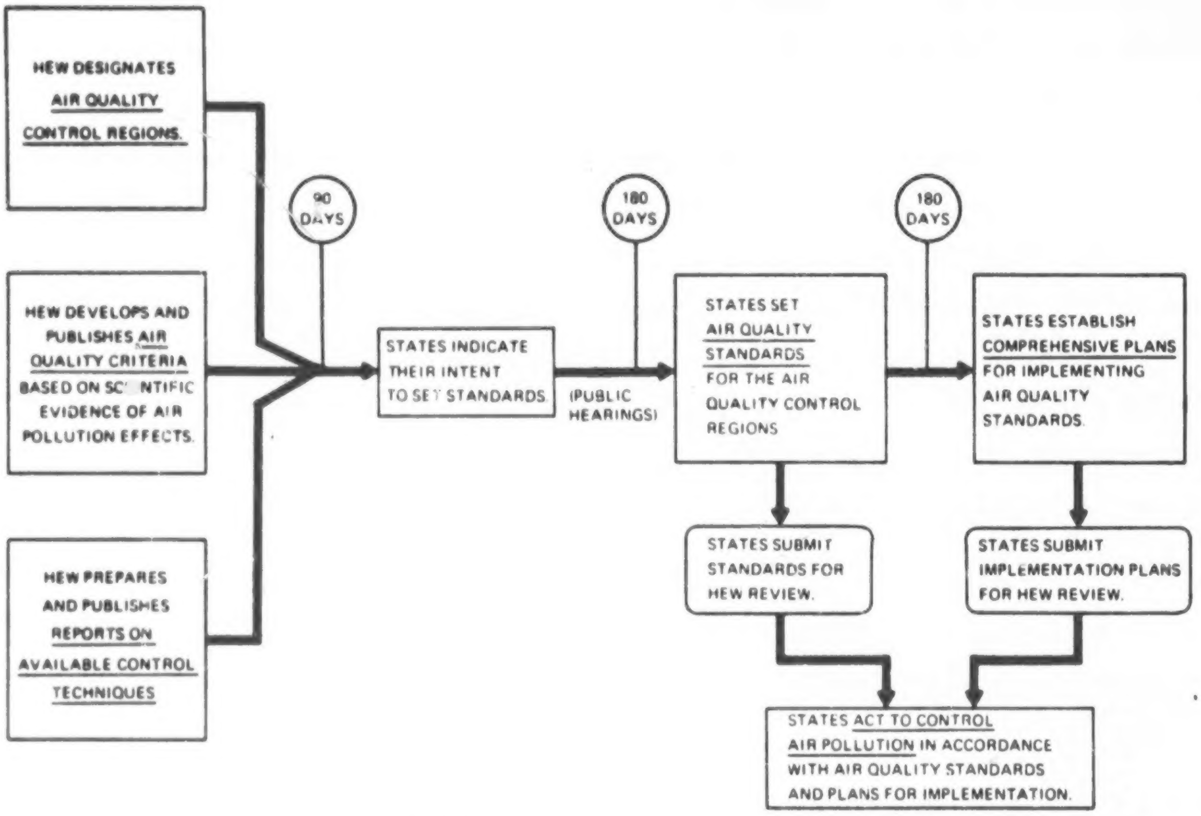
HEW DESIGNATES AIR QUALITY CONTROL REGIONS.
HEW DEVELOPS AND PUBLISHES AIR QUALITY CRITERIA BASED ON SCIENTIFIC EVIDENCE OF AIR POLLUTION EFFECTS.
HEW PREPARES AND PUBLISHES REPORTS ON AVAILABLE CONTROL TECHNIQUES
90 DAYS
STATES INDICATE THEIR INTENT TO SET STANDARDS.
180 DAYS
(PUBLIC HEARINGS)
STATES SET AIR QUALITY STANDARDS FOR THE AIR QUALITY CONTROL REGIONS
180 DAYS
STATES ESTABLISH COMPREHENSIVE PLANS FOR IMPLEMENTING AIR QUALITY STANDARDS.
STATES SUBMIT STANDARDS FOR HEW REVIEW.
STATES SUBMIT IMPLEMENTATION PLANS FOR HEW REVIEW.
STATES ACT TO CONTROL AIR POLLUTION IN ACCORDANCE WITH AIR QUALITY STANDARDS AND PLANS FOR IMPLEMENTATION.

Figure A-1 Regional Air Pollution Control Under the Clean Air Act as Amended.

receptors (people, plants, animals, and materials) exposed to these pollutants. Major metropolitan areas represent the highest concentrations of both emitters and receptors, although the pattern of receptors affected by pollution will vary according to local meteorological conditions.

In defining the physical or engineering factors of an air quality control region, NAPCA uses input data on pollutant emissions and meteorological factors. An emission inventory is prepared for the given area listing all major sources, types of pollutants, and quantities emitted under various climatological conditions. (Pollutants presently being considered include sulfur oxides, suspended particulate matter, and carbon monoxide.) The input for meteorological factors includes seasonal data on the inversion layer, wind direction, and wind velocity for the area. The statistical distribution of environmental factors and the natural diffusion characteristics of the given pollutants are also considered.

On the basis of all of the above data, average annual ground level concentrations of each pollutant during each season are computed, and an output is obtained in the form of a plot of contour lines defining equal pollutant concentrations within the geographic area. The extent of the regional pollution problem may then be readily determined.

Through analysis of these pollutant-concentration plots and their relation to urban and political boundaries, NAPCA defines an air quality control region for the given area. A number of control regions have been established by NAPCA on the basis of these studies, including those for the metropolitan areas listed in Appendix B.

(b) Air Quality Criteria. The Department of Health, Education and Welfare is responsible for developing and issuing air quality criteria. These criteria are to be based on current analyses of the adverse effects of specific air pollutants and combinations of pollutants on man and his environment. Although the evidence in the criteria documents will not necessarily be based precisely on levels of exposure below which there are no adverse effects, they will nonetheless provide quantitative guidance to the States for establishment of regional air quality standards. The documents on sulfur oxide and particulate matter criteria indicate the following:

(1) Under the conditions prevailing in areas where the studies were conducted, adverse health effects were noted when 24-hour average levels of sulfur dioxide exceeded 300 $\mu g/m^3$ (0.11 ppm) for 3 to 4 days. Adverse health effects were also noted when the annual mean level of sulfur dioxide exceeded 115 $\mu g/m^3$ (0.04 ppm). Visibility reduction to about 5 miles was observed at 285 $\mu g/m^3$ (0.12 ppm); and adverse effects on vegetation were observed at an annual mean of 85 $\mu g/m^3$ (0.03 ppm). It is reasonable and prudent to conclude that, in the promulgation of ambient air quality standards, consideration should be given to requirements for margins of safety which would take into account long-term effects on health, vegetation, and materials occurring below the above levels [Air Quality Criteria, SO_x].

(2) Under the conditions prevailing in areas where the studies were conducted, adverse health effects were noted when the annual mean level of particulate matter exceeded 80 $\mu g/m^3$. Visibility reduction to about 5 miles was observed at 150 $\mu g/m^3$, and adverse effects on materials were observed at an annual mean exceeding 60 $\mu g/m^3$. It is reasonable and prudent to conclude that, in the promulgation of ambient air quality standards, consideration should be given to requirements for margins of safety which would take into account long-term effects on health and materials occurring below the above levels [Air Quality Criteria, Particulates].

(c) Control Techniques. For each of the pollutants covered by a criteria document, the Department of Health, Education and Welfare issues a report on control techniques. These reports provide engineering handbook information on the physical characteristics, operating characteristics, and cost characteristics of control measures. From these documents, control cost-effectiveness information can be obtained for control devices, such as precipitators and fabric filters, or nondevice control measures, such as the use of low-sulfur-content fuels or alterations to basic industrial processes which lessen pollutant emissions [Control, SO_x; Control, Particulates].

(d) Air Quality Standards. Air quality standards, developed on the basis of the air quality criteria, are goals established by the States for the protection of public health and welfare. They provide the States with a basis for controlling existing sources of pollution emissions and preventing future regional growth from adding to the pollution problem. These goals are stated in the form of desired limits on the level of each particular air pollutant. The goals may reflect more than one air quality standard, specifying both minimum air quality level and higher levels of air quality. The goals must also preclude the possibility of significant deterioration in existing air quality levels.

(e) Implementation Planning. Implementation plans are blueprints for establishing and maintaining air quality standards. The major elements of a plan include:

- Information on existing source emission and air quality data
- Control plan for achieving ambient air quality standards
- Emergency episode authority and procedures
- Programs for monitoring air quality and emissions from sources
- Description of required legal authority
- Description of resources required by the plan.

APPENDIX B

CENTRAL CITIES OF THE AIR QUALITY CONTROL REGIONS

The regions listed in this appendix are not in the order of their original designation, but are in the order presented in the "Guidelines for the Development of Air Quality Standards and Implementation Plans" and a Department of Health, Education and Welfare news release dated April 5, 1970.

1. Washington, D. C.
2. New York
3. Chicago
4. Philadelphia
5. Denver
6. Los Angeles
7. St. Louis
8. Boston
9. Cincinnati
10. San Francisco
11. Cleveland
12. Pittsburgh
13. Buffalo
14. Kansas City
15. Detroit
16. Baltimore
17. Hartford
18. Indianapolis
19. Minneapolis - St. Paul
20. Milwaukee
21. Providence
22. Seattle - Tacoma
23. Louisville
24. Dayton
25. Phoenix
26. Houston
27. Dallas - Ft. Worth
28. San Antonio
29. Birmingham
30. Toledo
31. Steubenville
32. Chattanooga
33. Atlanta
34. Memphis
35. Portland, Oregon
36. Salt Lake City
37. New Orleans
38. Miami
39. Oklahoma City
40. Omaha
41. Honolulu
42. Beaumont - Port Arthur
43. Charlotte, N. C.
44. Portland, Maine
45. Albuquerque
46. Lawrence - Lowell - Manchester
47. El Paso
48. Las Vegas
49. Fargo - Moorhead
50. Boise
51. Billings
52. Sioux Falls
53. Cheyenne
54. Anchorage
55. Burlington
56. San Juan
57. Virgin Islands
58. Allentown - Bethlehem - Easton (Pa.) - Phillipsburg (N.J.)
59. Binghamton (N.Y.) - (Pa.)

60. Bristol (Va.) - Johnson City - Kingsport (Tenn.)
61. Columbus (Ga.) - Phonix City (Ala.)
62. Cumberland (Md.) - Keyser (W. Va.)
63. Duluth (Minn.) - Superior (Wisc.)
64. Erie (Pa.) - Ashtabula (Ohio)
65. Evansville (Ind.) - Owensboro - Henderson (Ky.)
66. Florence (Ala.) - (Miss.) - (Tenn.)
67. Fort Smith (Ark.) - (Okla.)
68. Huntington (W. Va.) - Ashland (Ky.) - Portsmouth - Ironton (Ohio)
69. Joplin (Mo.) - Miami (Okla.)
70. LaCrosse (Wisc.) - Winona (Minn.)
71. Menominee - Escanaba (Mich.) - Marinette (Wisc.)
72. Mobile (Ala.) - Pensacola (Fla.) - Biloxi - Gulfport (Miss.)
73. Paducah (Ky.) - Metropolis (Ill.)
74. Parkersburg (W. Va.) - Marietta (Ohio)
75. Rockford (Ill.) - Janesville - Beloit (Wisc.)
76. Sequatchie River Valley (Ala.) - (Tenn.)
77. South Bend - Elkhart (Ind.) - Benton Harbor (Mich.)
78. Youngstown - Warren (Ohio) - Sharon (Pa.)
79. Augusta (Ga.) - Aiken (S. C.)
80. Berlin (N. H.) - Rumford (Me.)
81. Davenport (Iowa) - Rock Island - Moline (Ill.)
82. Douglas (Ariz.) - Lordsburg (N. M.)
83. Dubuque (Iowa) - (Ill.) - (Wisc.)
84. Keokuk (Iowa) - (Ill.) - (Wisc.)
85. Lewiston - Moscow (Idaho) - Clarkston - Pullman (Wash.)
86. Norfolk (Va.) - Elizabeth City (N. C.)
87. Savannah (Ga.) - Beauford (S. C.)
88. Shreveport (La.) - Texarkana (Tex.) - (Ark.)
89. Sioux City (Iowa) - (Neb.)
90. Spokane (Wash.) - Coeur d'Alene (Idaho)
91. Vicksburg (Miss.) - Tallulah (La.)

APPENDIX C

REGIONAL AIR POLLUTION CONTROL DIRECTORS, NAPCA

(July 10, 1970)

REGION 1 -- Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

John F. Kennedy Federal Building
Boston, Massachusetts 02203
Phone: 617-223-6883 or 223-6339

REGION 2 -- New Jersey, New York, Puerto Rico, Virgin Islands

Federal Office Building
26 Federal Plaza (Foley Square)
New York, New York 10007
Phone: 212-264-2517

REGION 3 -- Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia

Post Office Box 12900
401 N. Broad Street
Philadelphia, Pennsylvania 19108
Phone: 215-597-9154

REGION 4 -- Alabama, Florida, Georgia, Mississippi, Kentucky, North Carolina, South Carolina, Tennessee

50 Seventh Street, N. E., Room 404
Atlanta, Georgia 30323
Phone: 404-526-3043

REGION 5 -- Illinois, Indiana, Minnesota, Michigan, Ohio, Wisconsin

New Post Office Building, Room 712
433 West Van Buren Street
Chicago, Illinois 60607
Phone: 312-353-6942

REGION 6 -- Arkansas, Louisiana, New Mexico, Oklahoma, Texas

Room 1414, 1114 Commerce Street
Dallas, Texas 75202
Phone: 214-749-3989 or 749-3980

REGION 7 -- Iowa, Kansas, Missouri, Nebraska

601 East 12th Street
Kansas City, Missouri 64106
Phone: 816-374-3791

REGION 8 -- Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming

Federal Office Building, Room 9017
Denver, Colorado 80202
Phone: 303-297-4682

REGION 9 -- Arizona, California, Hawaii, Nevada, Guam, American Samoa

Federal Office Building
50 Fulton Street
San Francisco, California 94102
Phone: 415-556-1105

REGION 10 -- Washington, Oregon, Idaho, Alaska

Arcade Building
1319 Second Avenue
Seattle, Washington 98101
Phone: 206-583-0530 or 0522

DATE
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PB 198-299

ENVIRONMENTAL PROTECTION AGENCY
Office of Air Programs
Research Triangle Park, North Carolina 27711

NOTICE

IPP Volume I Errata

The attached pages contain corrections and changes for the corresponding pages of the Air Quality Implementation Planning Program, Volume I, Operators Manual, Contract Number PH-22-68-68.

These pages should replace those in the published manual.

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TABLE 5-3

STANDARDIZED SOURCE TYPES (Continued)

2816 INORGANIC PIGMENTS

x0. Combustion
01. Calcination
02. Digestion
03. Chloride Process
04. Chloride Coke or Ore Drying
05. Ore Grinding
06. Titanium Oxide Ore Drying
07. Varnish Reaction Kettles

2818 INDUSTRIAL ORGANIC CHEMICALS, NOT ELSEWHERE CLASSIFIED

x0. Combustion
01. General

2819 INDUSTRIAL INORGANIC CHEMICALS, NOT ELSEWHERE CLASSIFIE

x0. Combustion
01. Sulfur Recovery Incinerator
02. Sulfuric Acid
03. Nitric Acid
04. Ammonium Nitrate
05. Hydrofluoric Acid
06. Calcium Carbide - Coke Dryer
07. Calcium Carbide - Electric Furnace Hood
08. Calcium Carbide - Electric Furnace Vents
09. Calcium Carbide - Stack
11. Calcium Carbide - Calcination
12. Phosphoric Acid

2821 PLASTICS MATERIALS, SYNTHETIC RESINS, AND NONVULCANIZABLE ELASTOMERS

x0. Combustion
01. General

2822 SYNTHETIC RUBBER (vulcanizable elastomers)

x0. Combustion
01. General

2833 MEDICINAL CHEMICALS AND BOTANICAL PRODUCTS

x0. Combustion
01. General

2834 PHARMACEUTICAL PREPARATIONS

x0. Combustion
01. General

5.4.2.2 Installation Cost

The cost of installing a control device on a particular source is calculated on the basis of an installation cost factor. This factor is expressed as a percentage of the purchase price and is a user input item for each control device. The program sums purchase cost and installation charge to determine the total installed cost for each source-device combination.

For some control device installations however, extensive modifications of the source are required and it is not possible to identify a purchase cost figure independent of the installation charge. For these devices, the total installed cost is estimated by the purchase price equations described in Subsection 5.4.2.1. No additional factor is required in these cases to account for installation at a source site. Devices in this category are the flue gas desulfurization units (039, 041, 042) and by-product manufacturing facilities (043, 044, 045).

5.4.2.3 Annual Capital Charge

After the total installed cost (purchase plus installation) of a device has been determined, an annualized capital charge is calculated, based on the user inputs: rated life of the control device and prevailing interest rate. Therefore, the annual cost comprises both depreciation of the initial investment total (installed cost from Subsection 5.4.2.2) and the interest costs.

The particular accounting technique employed here is called the Capital Recovery Factor (C.R.F.). The use of the C.R.F. allows the write-off of the initial investment to be divided into a uniform series of end-of-year payments.

The C.R.F. multiplied by the initial investment cost (debt) determines the uniform end-of-year payments necessary to repay the debt in "N" years (the rated life of the device) with an interest rate "i." The C.R.F. is calculated by the following relation:

(decimal equivalent).

$$\text{C.R.F.} = \frac{i(1 + i)^N}{(1 + i)^N - 1}$$

C = water quantity (gal/yr)	(b)
D = water cost (\$/gal)	(input as regional data)
E = chemical quantity (ton/yr)	(c)
F = chemical cost (\$/ton)	(input as device data)
G = fuel quantity (cu.ft./yr)	(d)
I = fuel cost (\$/cu. ft.)	(natural gas value, input as regional data)
J = disposal quantity (ton/yr)	(e)
K = disposal cost (\$/ton)	(input as device data)
L = labor quantity (hr/yr)	(f)
M = labor cost (\$/hr)	(input as regional data)

The computation of these data elements are as follows:

(a) Electricity Quantity (kwhr/yr) = $(1.955\ 10^{-4})pVH$

where p = pressure drop (in H_2O)

V = exhaust gas volume (ACFM) this is the new computed volume (x) in the case of a wet device (Subsection 5.4.2.1 item (a)).

H = operating hours (hr/yr)

If the device is one of the electrostatic precipitators (010, 011, 012), the following quantities are added to the electricity quantity:

Device 010, add $(0.34\ 10^{-3})$ VH

Device 011, add $(0.26\ 10^{-3})$ VH

Device 012, add $(0.19\ 10^{-3})$ VH

(b) Liquid Quantity (gal/yr) = $(3.0\ 10^{-2})$ VH

The liquid quantity is only computed for wet devices (001, 002, 003, 013). For these cases the exhaust gas volume (V) will always be the new computed volume.

(c) Chemical Quantity (ton/yr) = $P_s H$

where P_s = amount of SO_2 removed by the device [(tons/day)/(8 X SHIFTS)].

(d) Fuel Quantity = fVH

where f = 0.490, if device 019

0.245, if device 020

1.000, if device 021

TABLE 5-6

FUEL PARAMETERS

Symbol	Variable Name	Units	Where Obtained
--	Source ID number	--	Source data
A_i	Amount of each existing fuel burned	Tons, gallons, cu. ft. per day*	Source data
S_i	Sulfur content of each existing fuel burned	Percent by weight	Source data
H_i	Heat content of each existing fuel burned	BTU per ton, gallon or cu. ft.*	Source data
a	Ash content of coal burned	Percent by weight	Source data
D_j	Existing device efficiency for each pollutant	Decimal fraction	Source data
e_j	Emission rate for each pollutant	Tons per day	Source data
C_i	Unit cost of each existing fuel burned	Dollars per ton gallon, cu. ft.*	Region data
S_{Ni}	Sulfur content of each new fuel available	Percent by weight	Region data
H_{Ni}	Heat content of each new fuel available	BTU per ton, gallon or cu. ft.*	Region data
a_N	Ash content of each new coal available	Percent by weight	Region data
MA_i	Maximum allowable sulfur content for each fuel type	Percent by weight	Region data

i subscripts refer to type of fuel (C - coal, R - residual oil, D - distillate oil, G - gas)

j subscripts refer to pollutant (S - SO_x, P - particulate)

---

*For coal, oil and gas respectively.

Devices 030, 031, 032

For the sulfur limitation methods, a number of fuels may be eliminated in favor of a number of others, but the substitutions are made on a one-for-one basis so that the usable heat produced by an eliminated fuel will be exactly matched by the usable heat produced by the corresponding substitute fuel, i.e.,

$$B_{Ni}\ (i = C, R, D, \text{ or } G) = B_i\ (i = C, R, \text{ or } D)$$

The process is repeated unti the requirements are met or the fuel types available for substitution are exhausted, in which case the program will print a message to the user and go on to the next control method (device) in the table.

The amount(s) of new fuel(s) is then determined from the following equation:

$$A_{Ni} = \frac{B_{Ni}}{H_{Ni}\ (\text{Boiler Eff.})_{Ni}} \quad (i = C, R, D, \text{ or } G)$$

The annual cost of each new fuel is then computed as

$$P_{Ni} = A_{Ni}\ C_{Ni}.$$

Summing P_{Ni} for all new fuels used gives the total annaul cost of the fuel(s). The annual costs of the fuels to be eliminated (P_i) are then summed. The total additional annual fuel cost (C_{add}) is the total new fuel sum minus the total old fuel sum.

The new (controlled) emission rates are now calculated by use of the following equations:

$$e_{NS} = \Bigg[\frac{e_S}{1-D_S} - E_S + (19.0\ A_{NC}\ S_{NC}\ 10^{-3}) + (79.3\ A_{NR}\ S_{NR}\ 10^{-6}) + (71.8\ A_{ND}\ S_{ND}\ 10^{-6}) + (.2\ A_{NG}\ 10^{-9})\Bigg] \quad (1 - D_S)$$

$$e_{NP} = \Bigg[\frac{e_P}{1-D_P} - E_P + (.5\ A_{NC}\ a_N\ f_1\ 10^{-3}) +$$

$$+ (.5\ A_{NR}\ f_2\ 10^{-6}) + (.5\ a_{ND}\ f_2\ 10^{-6})$$

$$+ (.5\ A_{NG}\ f_2\ 10^{-9})\Bigg]$$

The decimal efficiencies of the control method are calculated from:

$$D_{NS} = 1 - \frac{e_{NS}}{e_S}\ ;\ D_{NP} = 1 - \frac{e_{NP}}{e_P}$$

The final calculations for the fuel substitution methods consist of: (1) summing the total fuel, by fuel category, used by the source after application of each method and (2) for devices 030, 031, and 032, calculating the sulfur dioxide allowable emission rate.

The sulfur dioxide allowable emission rate for devices 030, 031, and 032 is based upon the existing source emissions and upon the existing and allowable sulfur content. If a source already uses fuel with a sulfur content at or below the allowable levels then the allowable emission rate is set equal to existing emissions. If sulfur content levels higher than the maximum allowable are being used then the following computation is carried out for each fuel type.

$$\text{Allowable Emission}_i = \text{Existing Emission}_i\ \frac{\text{Allowable Sulfur Content}_i}{\text{Existing Sulfur Content}_i}$$

where the existing emission rate used in this equation represent the emissions from a particular fuel type. These allowable emissions are then summed by fuel type to provide an overall allowable source emission rate under the sulfur content limitation specified by the control measure.

5.5 PROGRAM OUTPUT

The Control Cost Program produces output in printed table form and on magnetic tape. The magnetic tape output, defined as the Control Cost File, is used by the Emission Standards Program. Both types of output contain the same information. As a result, the tabular data may be used to verify the Control Cost Program results before proceeding with the Emission Standards Program run. Example computer generated output for the Control Cost Program is presented in Subsection 7.5.

outputs this data in punched card form so that an isopleth plot can be produced for easy visualization of the resulting concentrations.

If projection factors are used to produce simulated emission levels representing some future time period, the following three tables will also be output by the Regional Strategies Program.

- Projected Emission Inventory - This output indicates the revised projected emission levels for each emission source within the region. Both the existing emission rate and the "allowable" emission, as defined by the emission standards which make up the control strategy, are displayed in this tabulation.
- Projected Emissions Summary - This is a summary table showing the accumulated projected emission levels for each political jurisdiction and on a region wide basis.
- Projected Ground Level Concentrations - When the user selects the projection option, the Regional Strategies Program produces a tabulation of ground level pollutant concentrations based on the projected emission levels. A punched card output from which isopleth maps may be produced is also generated. This output, both printed and punched cards, uses the same format as the mean pollutant concentration output, without projection.

TABLE 7.2-1

ACTION CARD FORMAT

Column	Picture	Description	Edit Action
1-3	XXX	Region Number * (001 thru 999)	
4-9	AAAAAA	Action Code; enter CREATE or UPDATE	Create or Update
10-27	18A	Creation or Update Date; this date is printed by other programs to identify Source File used.	
28-80	Blanks		
-- For Create or Update use Above Format; For List Use Format Below --			
1-3	XXX	Region Number *	
4-9	AAAAAA	Action Code; Enter LIST (left justified)	List
10-29	20A	Region Name	
30-80	Blanks		

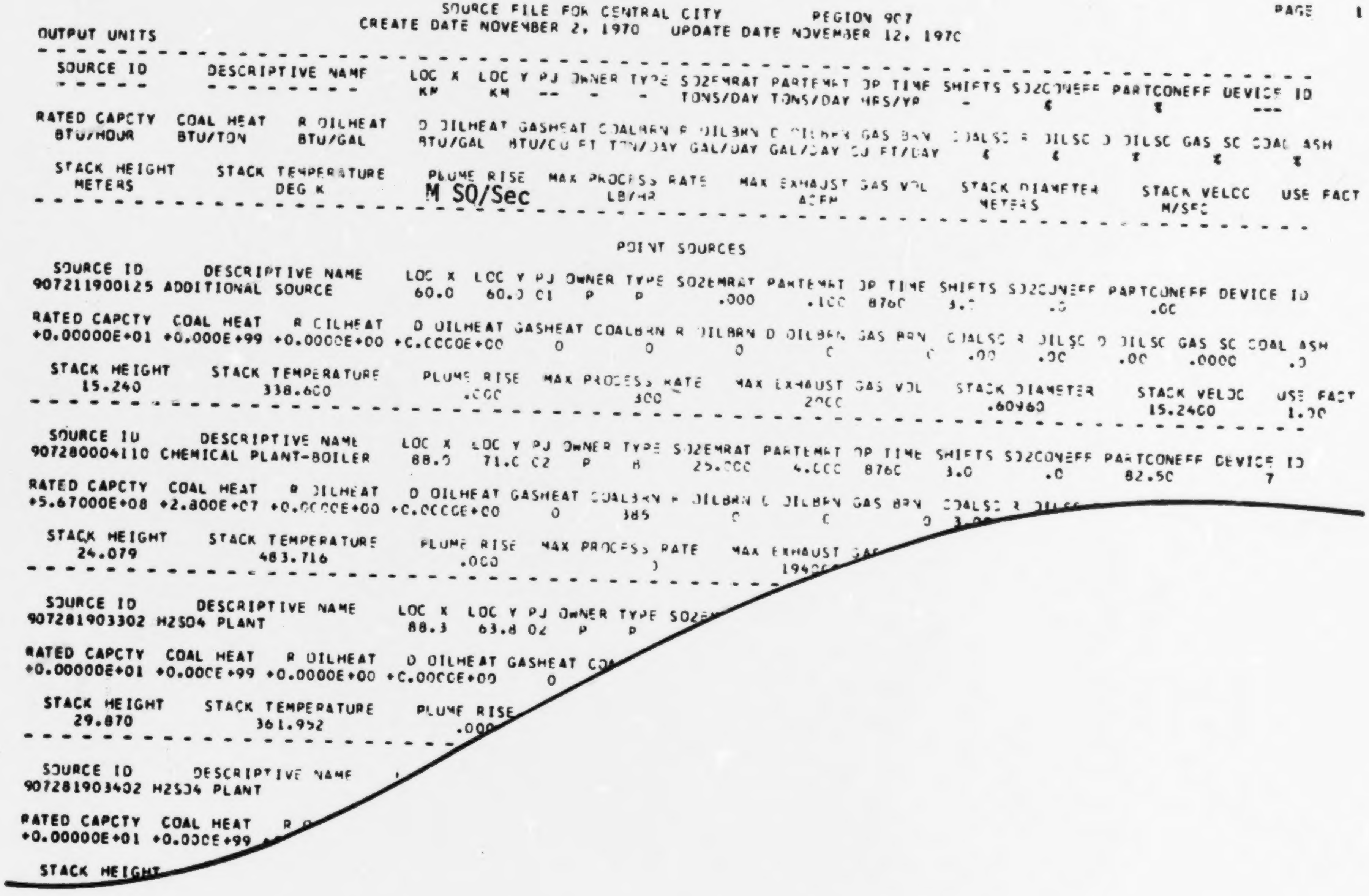
* Right Justified

TABLE 7.2-2C

POINT SOURCE INPUT FORMAT

(Card Number 3)

Column	Picture	Description	Program Editing Action
1-3	XXX	Region Number	Identification field - see Card No. 1
4-7	XXXX	SIC Code	
8-10	XXX	Site Number	
11-12	XX	Process Code	
13-16	XXXX	Stack Height (ft)	If non-blank, must be numeric; converts to meters
17-20	XXXX	Stack Temperature in (°F)	If non-blank, must be numeric; converts to °Kelvin
21-24	XXXX	Normalized Plume Rise in (ft^2/sec)	If non-blank, must be numeric; converts to m^2/sec
25-30	XXXXXX	Maximum Process Rate in (10^2 lb/hr)	If non-blank, must be numeric; converts to lb/hr
31-35	XXXXX	Maximum Exhaust Gas Volume (10^2 ACFM)	If non-blank, must be numeric; converts to ACFM
36-38	XX.X	Stack Diameter (ft)	If non-blank, must be numeric; converts to meters
39-41	XXX	Stack Velocity (ft/sec)	If non-blank, must be numeric; converts to m/sec
42-44	X.XX	Use Factor	If non-blank, must be numeric
45-78	Blank		



```
                          SOURCE FILE FOR CENTRAL CITY          REGION 907                                        PAGE    1
OUTPUT UNITS           CREATE DATE NOVEMBER 2, 1970   UPDATE DATE NOVEMBER 12, 1970
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
  SOURCE ID      DESCRIPTIVE NAME     LOC X  LOC Y PJ OWNER TYPE SO2EMRAT PARTEMAT OP TIME SHIFTS SO2CONEFF PARTCONEFF DEVICE ID
  - - - - -      - - - - - - - -       KM     KM   --   -     -   TONS/DAY TONS/DAY HRS/YR    -        %          %        ---

RATED CAPCTY  COAL HEAT    R OILHEAT    D OILHEAT GASHEAT COALBRN R OILBRN D OILBRN GAS BRN  COALSC R OILSC D OILSC GAS SC COAL ASH
 BTU/HOUR     BTU/TON      BTU/GAL      BTU/GAL   BTU/CU FT TON/DAY GAL/DAY GAL/DAY CU FT/DAY  %        %        %       %       %

  STACK HEIGHT     STACK TEMPERATURE     PLUME RISE  MAX PROCESS RATE    MAX EXHAUST GAS VOL    STACK DIAMETER     STACK VELOC    USE FACT
    METERS               DEG K           M SQ/Sec         LB/HR                 ACFM                 METERS             M/SEC
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

                                                          POINT SOURCES

  SOURCE ID       DESCRIPTIVE NAME     LOC X  LOC Y PJ OWNER TYPE SO2EMRAT PARTEMAT OP TIME SHIFTS SO2CONEFF PARTCONEFF DEVICE ID
907211900125 ADDITIONAL SOURCE          60.0   60.0 C1   P     P      .000     .100   8760    3.0        .0        .00

RATED CAPCTY  COAL HEAT    R OILHEAT    D OILHEAT GASHEAT COALBRN R OILBRN D OILBRN GAS BRN  COALSC R OILSC D OILSC GAS SC COAL ASH
+0.00000E+01 +0.000E+99 +0.0000E+00 +0.0000E+00     0        0        0        0         0    .00     .00     .00    .0000      .0

  STACK HEIGHT     STACK TEMPERATURE     PLUME RISE  MAX PROCESS RATE    MAX EXHAUST GAS VOL    STACK DIAMETER     STACK VELOC    USE FACT
    15.240              338.600             .000          300                  2000                 .60960           15.2400        1.00
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

  SOURCE ID       DESCRIPTIVE NAME     LOC X  LOC Y PJ OWNER TYPE SO2EMRAT PARTEMAT OP TIME SHIFTS SO2CONEFF PARTCONEFF DEVICE ID
907280004110 CHEMICAL PLANT-BOILER      88.0   71.0 C2   P     H    25.000    4.000   8760    3.0        .0      82.50          7

RATED CAPCTY  COAL HEAT    R OILHEAT    D OILHEAT GASHEAT COALBRN R OILBRN D OILBRN GAS BRN  COALSC R OILSC
+5.67000E+08 +2.800E+07 +0.0000E+00 +0.0000E+00     0      385        0        0         0  3.00

  STACK HEIGHT     STACK TEMPERATURE     PLUME RISE  MAX PROCESS RATE    MAX EXHAUST GAS
    24.079              483.716             .000            0                  194
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

  SOURCE ID       DESCRIPTIVE NAME     LOC X  LOC Y PJ OWNER TYPE SO2E
907281903302 H2SO4 PLANT                88.3   63.8 02   P     P

RATED CAPCTY  COAL HEAT    R OILHEAT    D OILHEAT GASHEAT CO
+0.00000E+01 +0.000E+99 +0.0000E+00 +0.000CE+00     0

  STACK HEIGHT     STACK TEMPERATURE     PLUME RISE
    29.870              361.952             .000
- - - - - - - - - - - - - - - - - - - - - - - - - -

  SOURCE ID       DESCRIPTIVE NAME
907281903402 H2SO4 PLANT

RATED CAPCTY  COAL HEAT    R O
+0.00000E+01 +0.000E+99

  STACK HEIGHT
```

Figure 7.2-7. Output Format - Point Source Listing.

TABLE 7.3-1

PUNCHED CARD INPUT FOR THE AIR POLLUTANT CONCENTRATION PROGRAM

Data Type	Description
MN	&INDATA - A NAMELIST variable indicating the start of a list of namelist inputs. No equals sign or values are associated with this variable.
ONA	REGI0N - Up to 24 characters (preceded by an apostrophe and followed by an apostrophe and comma) may be used to describe the region being run. If omitted, the Region designation will be blank.
ONA	DATE - Up to 20 characters (preceded by an apostrophe and followed by an apostrophe and comma) may be used to define the run date. If omitted, the date will be blank.
ONI	IP0LU1 - Flag to indicate single pollutant run: one (1) indicates consideration of SO_2 only and a two (2) indicates consideration of particulates only. If omitted or input as zero (0), both pollutants are considered.
MNP	DPTHMX - Mixing height (meters).
MNP	WNDFRQ - Relative frequency of occurrence for each wind speed class, wind direction, and wind stability class combination (480 values). The order of input for the frequency values associated with each stability-wind direction-wind speed combination is as follows: stability 1-direction 1-speed 1, stability 1-direction 1-speed 2,-----, stability 1-direction 1-speed 6, stability 1-direction 2-speed 1, -----, stability 1-direction 2-speed 6,-----, stability 1-direction 16-speed 6,-----, stability 2-direction 1-speed 1,-----, stability 5-direction 16-speed 6.
MNP	TA - Average ambient temperature (degrees Kelvin).
MNP	PA - Average ambient pressure (millibars).
MNP	BLIFE - Half-life factors (hours). The data must be provided in the order: SO_2, Particulate matter. If BLIFE < .25 the program assumes an infinite half-life.
ONP	BACKGR - Background concentrations (arithmetic mean, micrograms per cubic meter) for each pollutant in the order: SO_2, particulate matter. If omitted background values are assumed to be zero.
ONI	INCRX - Number of columns in the receptor grid. If omitted, this variable is assumed to be zero.

TABLE 7.3-1

PUNCHED CARD INPUT FOR THE AIR POLLUTANT CONCENTRATION PROGRAM (Continued)

Data Type	Description
ONI	INCRY - Number of rows in the receptor grid. If omitted, this variable is assumed to be zero.
ONP	DELTA - Distance (kilometers) between two adjacent rows or columns. If omitted, this variable is assumed to be zero.
ONP	RBASE - X and Y coordinates (kilometers) of southwest corner of receptor grid system. If omitted, these variables are assumed to be zero, zero.
ONI	IADD - Total number of non-grid receptors. This value must be less than or equal to 50. If omitted, this variable is assumed to be zero. If input, XRECEP values must be input.
	NOTE: If both the grid system and IADD are omitted, the run will terminate and print the message: 'IMPROPER RECEPTOR INPUT - RUN TERMINATED.'
ONP	XRECEP - X, Y (kilometers) coordinates for the IADD non-grid receptors. If IADD is non-zero, these values must be input.
ONI	IPUNCH - Flag to indicate whether receptor ground level concentration output is to be punched on cards (for use in plotting concentration isopleths). Set to one (1) for punched card output; a zero (0) indicates no punched card output. If omitted, flag will be set to one (1).
MNI	IREG - Flag to indicate which regression option is to be used. A zero (0) indicates that input regression constants are required; one (1) indicates calibration of the model followed by the model run; a two (2) indicates calibration only. If calibration values are to be calculated (IREG = 1 or 2), the following variables must be input: number of stations (NS02 and/or NPART), and station location and measured concentration data (S020B and/or PAR0B). If the calibration constants are input, they are defined by S02CAL and/or PARCAL.
ONP	S02CAL - Regression line constants (y-intercept, slope) for sulfur dioxide. If omitted (and IREG = 0), this variable is set to zero, one.
ONP	PARCAL - Regression line constants (y-intercept, slope) for suspended particulate matter. If omitted (and IREG = 0), this variable is set to zero, one.

TABLE 7.3-1

PUNCHED CARD INPUT FOR THE AIR POLLUTANT CONCENTRATION PROGRAM (Continued)

Data Type	Description
ONI	NS02 - Number of SO_2 measuring stations (100 Maximum). If omitted, this variable is assumed to be zero.
ONI	NPART - Number of particulate measuring stations (100 Maximum). If omitted, this variable is assumed to be zero.
ONP	S020B - Up to one hundred (100) sets of SO_2 measuring station locations and measured concentration values are input in the following order for each station: x-coordinate and y-coordinate of station and measured concentration value. If omitted, this variable is assumed to contain zero for all values.
ONP	PAR0B - Up to one hundred (100) sets of particulate matter measuring stations and measured concentration values are input in the following order for each station: x-coordinate and y-coordinate of station and measured concentration value. If omitted, this variable is assumed to contain zero for all values.
ONI	ISTAT - Flag to indicate if table data is desired: zero (0) for no output, one (1) for output. These data include the Excess Concentration Table, Source Contribution Table and the Statistical Tables. If omitted, this variable is set to zero.
ONP	AQSTAN - Air quality standard for each pollutant (arithmetic mean in micrograms per cubic meter) input in the order: SO_2, and particulate matter. If omitted, this variable assumed to be zero, zero.
ONI	NSEL5 - Flag to indicate if the five (5) receptors on the Source Contribution table are input (NSEL5 = 1) or are the five receptors of maximum concentration and therefore selected by the program (NSEL5 = 0). If omitted, NSEL5 = 0.
ONI	IC0NS - Five (5) SO_2 receptor location numbers for source contribution table output. If NSEL5 = 1, all 5 values must be input.*

---

*See Footnote on following page.

TABLE 7.3-1

PUNCHED CARD INPUT FOR THE AIR POLLUTANT CONCENTRATION PROGRAM (Continued)

Data Type	Description
ONI	IC0NP - Five (5) particulate matter receptor location numbers for source contribution table output. If NSEL5 = 1, all 5 values must be input.*
ONI	NSEL12 - Flag to indicate whether statistical output is desired: zero (0) for no, one (1) for yes. If statistical output is requested, the following variables must also be present: Up to twelve (12) receptor numbers per pollutant for statistical output (ISTATS and/or ISTATP); standard geometric deviations corresponding to each receptor number specified (SGDS and/or SGDP); five (5) averaging times for each pollutant (S02AVG and/or PARAVG); and three (3) percentile values (PERCNT). If omitted, NSEL12=0.
ONI	ISTATS - Twelve (12) SO_2 receptor location numbers for statistical output.*
ONI	ISTATP - Twelve (12) particulate matter receptor location numbers for statistical output.*
ONP	S02AVG - Five averaging times for SO_2 expressed in hours.
ONP	PARAVG - Five averaging times for particulate matter expressed in hours.
ONP	SGDS - Standard geometric deviation (24-hour period) for SO_2 corresponding to the ISTATS receptor numbers. These values must be input in the same order as the receptor location numbers to which they refer.
ONP	SGDP - Standard geometric deviations (24-hour period) for particulate matter corresponding to the ISTATP receptor numbers. The values must be input in the same order as the receptor location numbers to which they refer.

---

*Receptor location numbers are selected from the basic set of input receptors. The numbering system of the basic set is defined as follows: first number the grid receptor locations consecutively, increasing from bottom to top within each column and by column from left to right; then number the non-grid receptors, continuing from the last grid receptor number in the order they are input. The basic set will then contain INCRX*INCRY + IADD receptor numbers.

of: the expected arithmetic mean (used here in the sense of predicted or estimated arithmetic mean) from the program; the standard geometric deviation, which is the input value converted to the desired averaging time; and the expected geometric mean and expected maximum concentration values, which are calculated from the expected arithmetic mean and standard geometric deviation values. Again, if calibration of the model was requested and was successful, the arithmetic mean values used in this calculation will have been adjusted using the regression line parameters. In addition, this output lists the expected ground-level concentrations at three input percentile values (other than the maximum value).

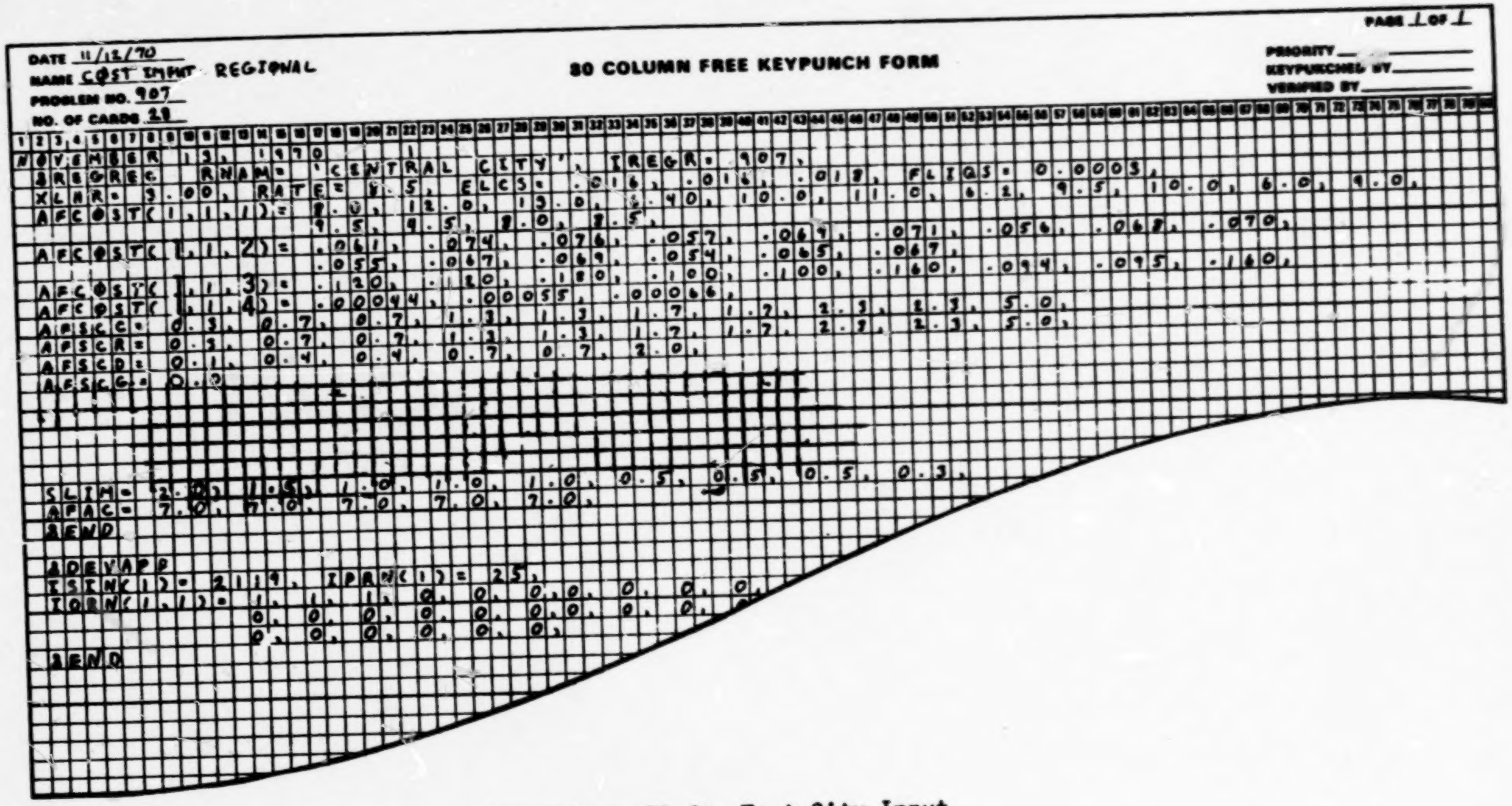
Source Contribution to Five Selected (or Maximum) Receptors (Figure 7.3-13)

The contributions of each point and area source in the region to the five selected or five maximum receptors (as requested by the user) are output for each pollutant. The source numbers correspond to those used in the Source Data Table (Figure 7.3-5).

The contribution of a given source to each receptor is indicated both as a percentage of the total concentration at the receptor and as an absolute value (microgram/cubic meter). The contribution of the background concentration, which is constant throughout the region, is shown in the second line from the bottom. The last line contains the total contribution from all sources for each receptor. Since all source contributions and background values are summed, the percentage figure will total 100% and the absolute value will equal the total concentration at each receptor (i.e., the last figure in each receptor column will be the same as that in the Receptor Concentration Data Table (Figure 7.3-10).

Punched Card Output (Table 7.3-2)

The data printed in the Receptor Concentration Data Table (Figure 7.3-4) is also punched on cards for use with surface contour programs. The Air Pollutant Concentration Program provides only the punched cards; a separate computer program is required to generate contour (isopleth) maps. Since many of the surface contour programs utilize input data in integer form, the concentration values are scaled by a factor of 100. Table 7.3-2 shows the punched card format used.



DATE 11/12/70
NAME CØST INPUT REGIONAL
PROBLEM NO. 907
NO. OF CARDS 28

80 COLUMN FREE KEYPUNCH FORM

PAGE 1 OF 1
PRIORITY
KEYPUNCHED BY
VERIFIED BY

```
NOVEMBER 13, 1970
 &REGREC   RNAM= 'CENTRAL CITY', IREGR= 907,
 XLHR= 3.00, RATE= 8.5, ELCS= .016, .016, .018, FLIQS= 0.0005,
 AFCØST(1,1,1)= 8.0, 12.0, 13.0, 8.40, 10.0, 11.0, 6.2, 9.5, 10.0, 6.0, 9.0,
                9.5, 9.5, 8.0, 8.5,
 AFCØST(1,1,2)= .061, .074, .076, .057, .064, .071, .056, .068, .070,
                .055, .067, .069, .054, .065, .067,
 AFCØST(1,1,3)= .120, .120, .180, .100, .100, .160, .094, .095, .160,
 AFCØST(1,1,4)= .00044, .00055, .00066,
 AFSCC= 0.3, 0.7, 0.7, 1.3, 1.3, 1.7, 1.7, 2.3, 2.3, 5.0,
 AFSCR= 0.3, 0.7, 0.7, 1.3, 1.3, 1.7, 1.7, 2.3, 2.3, 5.0,
 AFSCD= 0.1, 0.4, 0.4, 0.7, 0.7, 2.0,
 AFSCG= 0.0


 SLIM= 2.0, 1.5, 1.0, 1.0, 1.0, 0.5, 0.5, 0.5, 0.3,
 APAC= 7.0, 7.0, 7.0, 7.0, 7.0,
 &END

 &DEVAPP
 ISINK(1)= 2119, IPRN(1)= 25,
 IORN(1,1)= 1, 1, 1, 0, 0, 0,0, 0, 0, 0,
            0, 0, 0, 0, 0, 0,0, 0, 0, 0,
            0, 0, 0, 0, 0, 0,

 &END
```

See Volume II for Test City Input.

Figure 7.5-4. Example Input Data Form for the Control Cost Program

```
            REGION:  CENTRAL CITY                    DEVICE DATA                                        DATE:  NOVEMBER 13, 1970

                                    RATED EFF     MANUFACTURERS PRICE COEFF         INST CHEM  DISP COST   LABOR QUANTITY        DEV PRS FUEL
 ID  ____DEVICE NAME________     _SO2 PART   _____1____ ____2_____ ____3_____ EACH COST __SO2 _PART SML_ MED_ LGE_ X-LG  LFE DRP EACH

  1 WET SCRUBBER HI EFFIC         0.0 98.0   0.289E 01  0.228E 00  0.0          2.00  0.0   0.0    1.0 0.50 1.00 2.00 4.00   15  20 0.0
  2 WET SCRUBBER MED EFFIC        0.0 90.0   0.289E 01  0.228E 00  0.0          2.00  0.0   0.0    1.0 0.38 0.75 1.50 3.00   15   4 0.0
  3 WET SCRUBBER LO EFFIC         0.0 80.0   0.126E 01  0.145E 00  0.0          2.00  0.0   0.0    1.0 0.38 0.75 1.50 3.00   15   3 0.0
  4 GRAV COLLECTOR HI EFFIC       0.0 60.0  -0.445E 00  0.326E 00  0.0          1.00  0.0   0.0    1.0 0.25 0.50 1.00 2.00   15   0 0.0
  5 GRAV COLLECTOR MED EFFIC      0.0 40.0  -0.420E-01  0.155E 00  0.0          1.00  0.0   0.0    1.0 0.25 0.50 1.00 2.00   15   0 0.0
  6 GRAV COLLECTOR LO EFFIC       0.0 30.0   0.300E-02  0.560E-01  0.0          1.00  0.0   0.0    1.0 0.25 0.50 1.00 2.00   15   0 0.0
  7 CYCLONE HI EFFIC              0.0 85.0   0.241E 01  0.197E 00  0.0          1.00  0.0   0.0    1.0 0.25 0.50 1.00 2.00   15   4 0.0
  8 CYCLONE MED EFFIC             0.0 75.0   0.151E 01  0.157E 00  0.0          1.00  0.0   0.0    1.0 0.25 0.50 1.00 2.00   15   3 0.0
  9 CYCLONE LO EFFIC              0.0 60.0   0.244E 00  0.990E-01  0.0          1.00  0.0   0.0    1.0 0.25 0.50 1.00 2.00   15   2 0.0
 10 ELECT PRECIP HI EFFIC         0.0 99.0   0.424E 02  0.623E 00  0.0          1.00  0.0   0.0    1.0 0.50 1.50 3.00 6.00   15   0 0.0
 11 ELECT PRECIP MED EFFIC        0.0 95.0   0.312E 02  0.441E 00  0.0          1.00  0.0   0.0    1.0 0.50 1.50 3.00 6.00   15   0 0.0
 12 ELECT PRECIP LO EFFIC         0.0 90.0   0.197E 02  0.318E 00  0.0          1.00  0.0   0.0    1.0 0.50 1.50 3.00 6.00   15   0 0.0
 13 GAS SCRUBBER                 80.0 80.0   0.317E 01  0.251E 00  0.0          2.00 10.0   0.0    1.0 0.38 0.75 1.50 3.00   15   5 0.0
 14 MIST ELIMINATOR HI VEL        0.0 99.0   0.266E 01  0.325E 00  0.0          1.00  0.0   0.0    0.0 0.25 0.50 1.00 2.00   15  10 0.0
 15 MIST ELIMINATOR LO VEL        0.0 85.0   0.177E 01  0.217E 00  0.0          1.00  0.0   0.0    0.0 0.25 0.50 1.00 2.00   15   5 0.0
 16 FABRIC FILTER HI TEMP         0.0 99.0   0.145E 01  0.838E 00  0.0          1.00  0.0   0.0    1.0 0.50 1.25 2.50 5.00   15   5 0.0
 17 FABRIC FILTER MED TEMP        0.0 95.0   0.348E 01  0.448E 00  0.0          1.00  0.0   0.0    1.0 0.50 1.25 2.50 5.00   15   5 0.0
 18 FABRIC FILTER LO TEMP         0.0 99.0   0.266E 01  0.325E 00  0.0          1.00  0.0   0.0    1.0 0.50 1.25 2.50 5.00   15   5 0.0
 19 CATALYTIC AFTERBURNER         0.0 95.0   0.755E 01  0.151E 01  0.0          1.00  0.0   0.0    0.0 0.25 0.50 1.00 2.00   15   1 0.49
 20 CATALYTIC AB WITH HE          0.0 95.0   0.755E 01  0.151E 01  0.0          2.00  0.0   0.0    0.0 0.25 0.50 1.00 2.00   15   1 0.24
 21 DIRECT FLAME AFTERBURNER      0.0 95.0   0.571E 01  0.117E 01  0.0          1.00  0.0   0.0    0.0 0.13 0.25 0.50 1.00   15   1 1.00
 22 DIRECT FLAME AB WITH HE       0.0 95.0   0.571E 01  0.117E 01  0.0          2.00  0.0   0.0    0.0 0.13 0.25 0.50 1.00   15   1 0.40
 27 ELIMINATE COAL                0.0  0.0   0.0        0.0        0.0          0.0   0.0   0.0    0.0 0.0  0.0  0.0  0.0     0   0 0.0
 28 ELIMINATE COAL AND R OIL      0.0  0.0   0.0        0.0        0.0          0.0   0.0   0.0    0.0 0.0  0.0  0.0  0.0     0   0 0.0
 29 SWITCH TO GAS                 0.0  0.0   0.0        0.0        0.0          0.0   0.0   0.0    0.0 0.0  0.0  0.0  0.0     0   0 0.0
 30 SULFUR LIMITATION 1           0.0  0.0   0.0        0.0        0.0          0.0   0.0   0.0    0.0 0.0  0.0  0.0  0.0     0   0 0.0
 31 SULFUR LIMITATION 2           0.0  0.0   0.0        0.0        0.0          0.0   0.0   0.0    0.0 0.0  0.0  0.0  0.0     0   0 0.0
 32 SULFUR LIMITATION 3           0.0  0.0   0.0        0.0        0.0          0.0   0.0   0.0    0.0 0.0  0.0  0.0  0.0     0   0 0.0
 39 CATALYTIC OXYDATION          90.0  0.0  -0.124E 02  0.167E 01  0.0          0.0   0.0 -27.6    0.0 0.0  0.0  0.0  0.0    15  41 0.0

 41 DRY LIMESTONE INJECTION      50.0  0.0   0.0        0.995E-06 -0.603E-16    0.0   2.0   0.0    0.0 0.0  0.0  0.0  0.0    15   0 0.0
 42 WET LIMESTONE INJECTION      80.0 98.0   0.111E-05  0.481E-16  0.0          0.0   2.0   0.0    0.0 0.0  0.0  0.0  0.0    15   0 0.0
 43 H2SO4 PLANT-CONTACT          97.5  0.0   0.0        0.800E 00  0.0          0.0   0.0 -27.6    0.0 0.0  0.0  0.0  0.0    20   0 0.0
 44 H2SO4 PLANT-2 CONTACT        99.5  0.0   0.0        0.800E 00  0.0          0.0   0.0 -27.6    0.0 0.0  0.0  0.0  0.0    20   0 0.0
 45 SULFUR PLANT                 95.0  0.0   0.0        0.810E 00  0.0          0.0   0.0 -15.0    0.0 0.0  0.0  0.0  0.0    20   0 0.0
```

Figure 7.5-6. Output Format - Device Data.

Items in the "DEV" line of Figure 7.5-8 are as follows:

.EFF (%) - gives the applied device efficiency

.STK TEMP
.EXHAUST VOL
New calculated values.

.TA COST
.OM COST
Annualized total and Operating Maintenance costs for device.

.EF C ($/T) - cost effectiveness if device
EFC = TA/[EMRT*EFF*365]

.Fuel UTL - in quantity of fuel used after device application.

TABLE 7.6-1

PUNCHED CARD INPUT FOR THE CONTROL COST FILE UPDATE PROGRAM

Card Type	Picture*	Description
NM	--	&STRATM - A NAMELIST variable indicating the start of NAMELIST inputs for a given record in the Control Cost File. No equals sign or values are associated with this variable.
MNI	XXX	IREGR - Region identification code.
MNI	XXXX	ISIC - SIC code.
MNI	XXX	ISIT - Site number.
MNI	XX	IPRC - Process code.
MMI	XX	IDDEV - Device number.

The above variables, and &END, are required for each record change. Of the following variables, only those being changed need be input.

Card Type	Picture*	Description
ONA	A	PRTYPE - Process type (B, P, or S).
ONI	XX	POLJUR - Political Jurisdiction.
ONP	X.XXX	DEVEFS - Applied SO_2 removal efficiency (decimal fraction) for device IDDEV.
ONP	X.XXXX	DEVEFP - Applied SO_2 Particulate removal efficiency (decimal fraction for device IDDEV.
ONP	XXXXX.XXX	EMRATS - Existing SO_2 emission rate (tons/day).
ONP	XXXXX.XXX	EMRATP - Existing Particulate emission rate (tons/day).
ONP	XX.X	SHIFTS - Number of shifts per day.
ONP	XXXXXXXX.	PRCRTM - Maximum process rate (lb/hr).

---

*Indicates the maximum dimension allowed.

TABLE 7.6-1

PUNCHED CARD INPUT FOR THE CONTROL COST FILE UPDATE PROGRAM (Continued)

Card Type	Picture*	Description
ONP	XXXXX.XXX	STKHTN - Stack height (meters).
ONP	XXX.XXXXX	STKDIA - Stack diameter, (meters).
ONP	XXXX.XXXX	EXVELN - Stack exit velocity (meters/second).
ONP	XXXXX.XXX	TEXN - Stack exit temperature, after control (degrees Kelvin).
ONP	XXXXXXX.XXXXX	RATCAP - Rated capacity (BTU/hr).
ONP	X.XXX	CONEFS - Existing device efficiency for SO_2 (decimal fraction).
ONP	X.XXXX	CONEFP - Existing device efficiency for Particulates (decimal fraction).
ONP	XXXXXXXX.	ACFMN - Exhaust gas volume after control (ACFM).
ONP	± XXXXXXXX.	TAC - Total annual cost ($/year).
ONP	XXXXXXX.XXX	HEC - Coal heat output, existing (BTU/year).
ONP	XXXXXXX.XXXX	HER - Residual oil heat output, existing (BTU/year).
ONP	XXXXXXX.XXX	HED - Distillate oil heat output, existing (BTU/year).
ONP	XXXXXXXXXX.	HEG - Gas heat output, existing (BTU/year).
ONP	XXXXXX.	AMC - Coal Burned, after control (tons/day).
ONP	XXXXXXX.	AMR - Residual oil burned, after control (gal/day).
ONP	XXXXXXX.	AMD - Distillate oil burned, after control (gal/day).

---

*Indicates the maximum dimension allowed.

TABLE 7.6-1

PUNCHED CARD INPUT FOR THE CONTROL COST FILE UPDATE PROGRAM (Continued)

Card Type	Picture*	Description
ONP	XXXXXXXXX.	AMG - Gas burned, after control (ft^3/day).
ONP	XX.XX	ØUSE - Use factor (decimal fraction).
ONP	XXXXXX.XXX	AEMIS - Allowable emission rate (tons/day).
ONI	X	IGAS - Gas cooling flag (1=yes, 0=no).
ONP	XXXXX.X	PLUME - Normalized plume rise (square meters/second). IUSE - not used by program
MN	--	&END - This variable signifies the end of the list of NAMELIST cards defining a given record.

---

*Indicates the maximum dimension allowed.

7.6.4 Output

After the cost file update operation is completed, the program produces a NAMELIST dump of the input and the updated file contents as illustrated in Figure 7.6-4. If the source identification is incorrect or the record change sets are out of order, the update operation will terminate with an error message indicating the problem. Note that alphabetic characters are not printed in a NAMELIST dump, thus the printout of the input PRTYPE:

TYPE	NAMELIST Output
B	-64.250977
P	-.12427946E28
S	-.21803474E41

7.7 EMISSION STANDARDS PROGRAM

7.7.1 Description

The Emission Standards Program utilizes input data from the Control Cost File and from punched card input. The Control Cost File data is listed in Table 7.6-1. The punched card input is described in this section.

The function of this program is to create an output file (Emission Standards File) containing those controlled sources which conform to specified emission standards. The file may then be used by the Regional Strategies Program. The fundamental sequence of events for operation of the Emission Standards Program is as follows:

(a) Call sort routine to order contents of the Control Cost File by;

Political jurisdiction - source category - source identification - device number.

(b) Input punched card data in the order; all data for political jurisdiction 1, all data for political jurisdiction 2, etc.

(c) The program reads in all punched card data for political jurisdiction 1, then the program will;

 (1) Read in all device application records for first source on sorted Control Cost File.

 (2) For each input standard which corresponds to the source category number, select the least expensive control device which satisfies the standard.

 (3) Repeat 1 and 2 for the second, third, etc., sources until all sources in the political jurisdiction have been considered.

(d) Output results to print routine and the Emission Standards File.

(e) The program then reads in the data for political jurisdiction 2, 3, ..., etc, repeating step (c) each time.

7.7.2 JCL and Deck Setup

Figure 7.7-1 illustrates an example deck setup for the execution of the Emission Standards Program. Figure 7.7-2 illustrates the specific JCL cards used for the execution of the test case. The general conditions illustrated in these figures are as follows:

TABLE 7.7-1

PUNCHED CARD INPUT FOR THE EMISSION STANDARDS PROGRAM

Data Type		Description	
	Column	Card Data	Format
MF		Region Card	
	1-3	• Region number, obtained from list in Appendix B.	Right Adjusted
	4-23	• Region name and/or run description.	--
	24-43	• Date.	--
MN		&ESTAND - a NAMELIST variable indicating start of a list of NAMELIST inputs for a particular political jurisdiction. No equals sign or values are associated with this variable.	
MNI		NPJ - number of the political jurisdiction for which this set of data is being input.	
ONA		NAMEPJ - up to 20 characters (preceded by an apostrophe and followed by an apostrophe and comma) identifying the political jurisdiction for which this set of data is being input.	
ONP		TAB01(1,P,C) - flag for application of the Null Standard. Set to 1. if standard is to be applied. TAB01(1,P,C) flag must be set for each desired combination of P = 1 or 2 and C = 1 or 2 or 3.	
ONP		TAB02(1,P,C) - flag for application of the Maximum Technology Standard. Set to 1. if standard is to be applied. TAB02(1,P,C) flags must be set for each desired combination of P = 1 or 2 and C = 1 or 2 or 3.	
ONI		NØBNO2 - set to 1 to eliminate open burning during application of TAB02(1,2,3).	
ONP		TAB03(1,P,C) - data for Maximum Technology (with Devices Excluded) Standard; Flag plus one to ten device numbers. If no devices are to be excluded, set flag to 1.. If from one to ten devices are to be excluded, set flag to 2. and input device identification	

- A data group for each political jurisdiction, in the order NPJ = 1, NPJ = 2, ..., etc., must follow the first card. All political jurisdictions must be represented.
- Within each data group defined by the beginning card &ESTAND NPJ = XX,NAMEPJ = XXXXX... and final card &END, data for each of the desired emission standard types must be specified.
- Data for each emission standard type is input through use of the NAMELIST variable;

  TABXX(1,P,C) = Flag, X_1, X_2, ...

  where

  XX = Emission Standard Type, EST01 through EST26 as described in Chapter 6.

  P = pollutant type: 1 = SO_2, 2 = particulates.

  C = Source Category: 1 = fuel combustion, 2 = industrial process, 3 = solid waste.

  Flag = Floating point indicator for pre-set or input data; set to 1. to indicate pre-set data is used (therefore, no data: X_1, X_2... will be input), 2. indicates input data is to be used, therefore the input data: X_1, X_2... must be included. The pre-set data for each standard is given in Table 7.7-2 (SO_2) and Table 7.7-3 (particulates).
- If no TABXX(1,P,C) = Flag, entry is made, the associated standard will not be applied, i.e., only those standards specified as either input or pre-set will be applied.
- The pollutant and source category ranges for which the standard is applicable are specified in its description (see also Table 7.7-2 and 7.7-3).
- If the standard is applied to solid waste-particulate control and open burning is to be eliminated, the flag NØBNXX = 1 must be input.
- An example data form is shown in Figure 7.7-4.
- All emission standard curves are log - log (base 10). All curve data must be input in pairs (independent variable, allowable emission) in ascending order by independent variable.

7.8 EMISSION STANDARDS FILE UPDATE PROGRAM

7.8.1 Description

The Emission Standards File Update Program is a COBOL program designed to change, delete or add records to the Emission Standards File. In addition, the program will produce a formatted listing of the new file after each update run is completed.

Input to the program consists of the Emission Standards File, on magnetic tape or disk, and punched cards describing the data which is to be added, changed, or deleted. The overall system flow of the Update Program is shown in Figure 7.8-1.

7.8.2 JCL Cards and Deck Setup

An example deck setup configuration is illustrated in Figure 7.8-2. Figure 7.8-3 contains the specific JCL cards, corresponding to the deck setup, which were used for the installation test case. The test case setup was based on the following configuration:

(a) Update program in object deck form
(b) Control Cost File on magnetic tape

Deviations from this configuration require appropriate JCL card changes.

7.8.3 Program Input

The update of the Emission Standards File is accomplished by means of fixed format punched cards. The description of the data fields for each record is given in Table 7.8-1. An example data form with prepared inputs is illustrated in Figure 7.8-4. The input requirements for each of the program operations is as follows:

(a) Record addition (Transaction Code = A) - All of the data shown in Table 7.8-1 must be completed.* If the Standard Number (01 through 26) being simulated by the addition is on the existing File (for the same pollutant-source category-political jurisdiction), a new number (27 and on) must be used. If this is not done, the Regional Strategies program cannot utilize the addition.

(b) Record change (Transaction Code = C) - The first 19 columns must be completed; followed by only those data elements to be changed.

* i.e., all fields must have at least its right hand column completed.

TABLE 7.8-1

PUNCHED CARD INPUT FOR EMISSION STANDARD FILE UPDATE PROGRAM (Card 2)

must always be completed

Columns	Picture*	Description
1	A	Transaction Code - Enter A if an entire record is to be added, D if an entire record is to be deleted, C if a record is to be changed.
2-4	XXX	Region Number - (001 through 999)
5-8	XXXX	SIC Code - (four digits)
9-11	XXX	Site Number - (001 through 999)
12-13	XX	Process Code - (00 through 99)
14-15	XX	Political Jurisdiction - (01 through 10)
16	X	Source Type - Enter 1 for fuel combustion, 2 for industrial process, 3 for solid waste disposal.
17	X	Pollutant Type - Enter 1 for SO_2 or 2 for particulates.
18-19	XX	Emission Standard Number - (01 through 26, see text for exclusions)
20-22	XXX	Device Number - (001 through 999)
23-31	XXXXXXXXX	Cost - Total annual cost, dollars (always positive)
32-34	.XXX	SO_2 Control Device Efficiency - Decimal equivalent
35-37	.XXX	Particulate Device Efficiency - Decimal equivalent
38-40	.XXX	Total Required Efficiency - Defined as: [potential emission minus allowable emission]/potential emission
41-47	XXXX.XX x	Allowed Emissions - tons/day
48-54	XXXX.XX x	Existing Emissions - tons/day
55	X	Gas Cooling Flag - Set flag = 0 for no gas cooling, set flag = 1 if gas cooling was used.
56-60	XXXXX	Quantity of Coal Used - tons/day

---

* See footnote on following page.

TABLE 7.8-1

PUNCHED CARD INPUT FOR EMISSION STANDARD FILE UPDATE PROGRAM **Card 2 (Continued)**

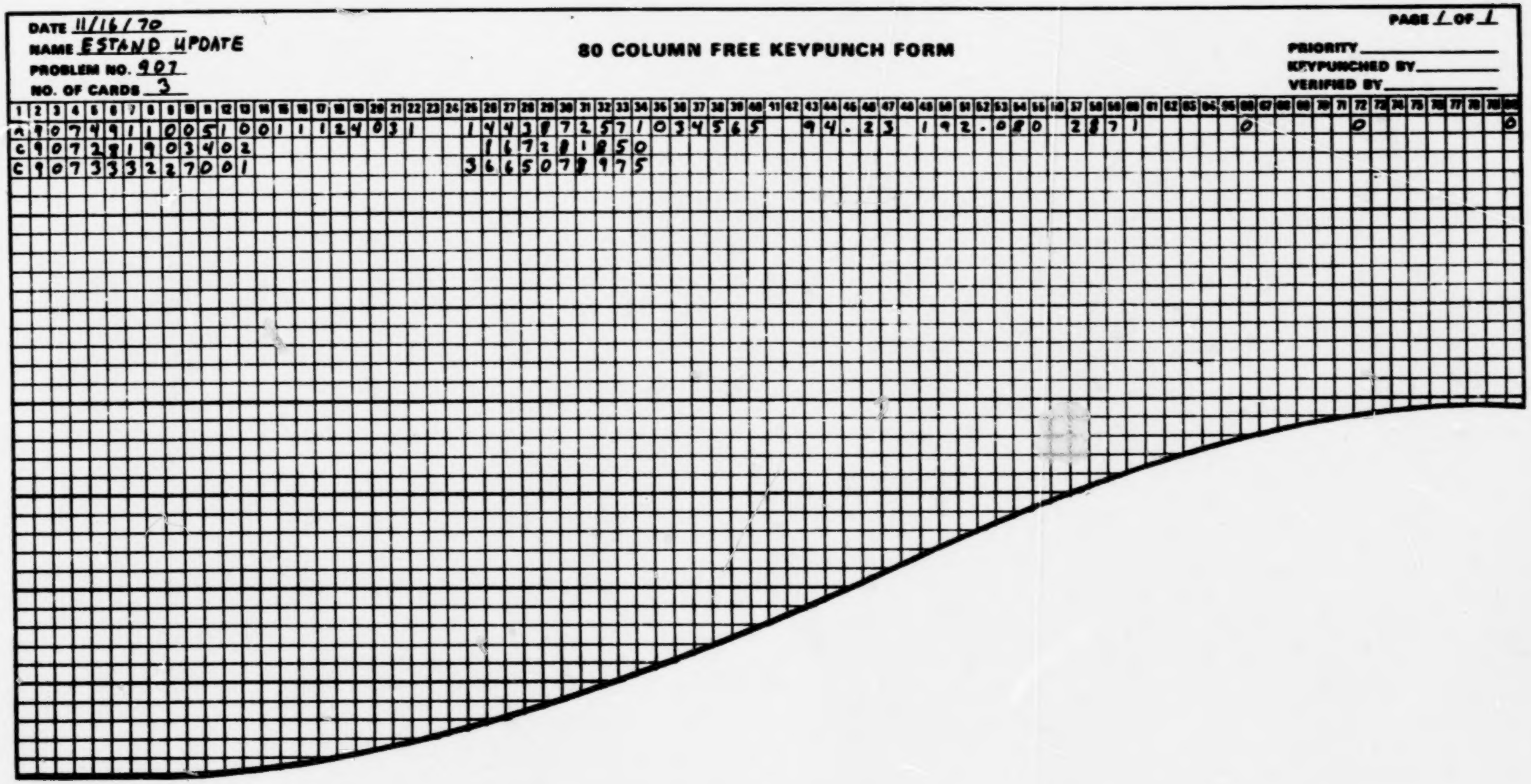
Columns	Picture*	Description
61-66	XXXXXX	Quantity of Residual Oil Used - tons/day
67-72	XXXXXX	Quantity of Distillate Oil Used - tons/day
73-80	XXXXXXXX	Quantity of Gas Used - ft^3/day

CARD 1 - TITLE DATE CARD

1 - 19	-----	Blank
20 - 39	20A	Region Name
40 - 57	18A	Date
58 - 80	-----	Blank

---

* NOTE:
1. All decimal points are implied.
2. All numeric values are right justified.
3. Since only those fields to be changed are input, blank fields are acceptable.
4. Within each field there can be no right justified blanks, i.e., all field entries must end with appropriate alphanumeric values.



DATE 11/16/70
NAME ESTAND UPDATE
PROBLEM NO. 907
NO. OF CARDS 3

80 COLUMN FREE KEYPUNCH FORM

PAGE 1 OF 1
PRIORITY
KEYPUNCHED BY
VERIFIED BY

```
A907491100510011124031  1443872571034565  94.23 192.080 2871     0     0       0
C907281903402            167281850
C907333227001           3665078975
```

See Volume II for Test City Input

Figure 7.8-4. Example Input Data Form for the Emission Standards File Update Program.

TABLE 7.9-1

PUNCHED CARD INPUTS FOR THE REGIONAL
STRATEGIES PROGRAM (Continued)

Data Type	Description
ONI	IPUNCH - Flag to indicate whether receptor ground level concentration output is to be punched on cards for use in plotting concentration isopleths. Set to one (1) if punched card output is desired. If omitted, punched card output will not be produced.
ONI	NSEL12 - Flag to indicate whether statistical output is desired. Set to one (1) if output is desired. If output is requested, the following variables must also be input: If SO_2 strategy, input ISTATS, S02AUG, SO2PER and SGDS. If particulate strategy, input ISTATP, PARAVG, PARPER and SGDP. If omitted, statistical output will not be produced.
ONI	ISTATS - From 1 to Twelve (12) receptor numbers for SO_2 statistical output.*
ONI	ISTATP - From 1 to Twelve (12) receptor numbers for particulate matter statistical output.*
ONP	S02AVG - From 1 to Three (3) averaging times (hours) for the SO_2 statistical output.
ONP	PARAVG - From 1 to Three (3) averaging times (hours for the particulate matter statistical output.
ONP	S02PER - Three (3) percentile levels (percent) for SO_2 statistical output.
ONP	PARPER - Three (3) percentile levels (percent) for particulate matter statistical output.
ONP	SGDS - Standard geometric deviation (24-hour period) for SO_2 corresponding to the ISTATS receptor numbers. These values must be input in the same order as the receptor location numbers to which they refer.

---

*Receptor location numbers must be consistent with the system defined for the associated Air Pollutant Concentration Program run (or Source Contribution File Merge Program run, if applicable).

TABLE 7.9-1

PUNCHED CARD INPUTS FOR THE REGIONAL STRATEGIES PROGRAM (Continued)

Data Type	Description
ONP	SGDP - Standard geometric deviation (24-hour period) for particulate matter corresponding to the ISTATP receptor numbers. These values must be input in the same order, as the receptor location numbers to which they refer.
ONI	IFAC - Flag to indicate whether individual area source scaling factors are input. Set to one (1) if individual scaling factors are input. If omitted, individual scaling factors will not be considered.
ONP	ASFAC - Area source scale factors to be applied on a political jurisdiction basis. A scale factor in the form +n.nn must be input for each pollutant - political jurisdiction combination. The order of input must be: SO_2-PJ#1, SO_2-PJ#2, ---, SO_2PJ# 10, Part-PJ#1, ----, Part-PJ#IJUR. If this card is input, all SO_2 scale factors must be specified then the particulate scale factors are specified. If omitted, all scale factors assume the value 1.0.
ONI	IPRØJ - Projection flag for projecting ground level concentration to some future date. Set to one (1) for point source and individual area source projections, set to two (2) for point source and political jurisdiction wide area source projections. If omitted, or set to zero (0), projections will not be considered.
ONP	ASPRJ - Area source projection factors to be applied (to the scaled area sources) on a political jurisdiction basis. A scale factor in the form +nnnnnnn.nn must be input for each pollutant - political jurisdiction combination. The order of input is the same as in ASFAC. If omitted, all area source projection factors assume the value 1.0.
MN	&END - This variable signifies the end of NAMELIST inputs.

TABLE 7.9-1

PUNCHED CARD INPUTS FOR THE REGIONAL STRATEGIES PROGRAM (Continued)

Data Type	Description
MF	Strategy cards - one card is input for each political jurisdiction, in the order: PJ#1, PJ#2, ----, PJ#IJUR. Each card contains the following data:

Columns	Description	Format (Right Justified)
1-3	Pollutant number; 1 for SO_2, 2 for particulates	nnn
4-6	Political jurisdiction number	nnn
7-9	Fuel combustion standard number	nnn
10-12	Industrial process standard number	nnn
13-15	Solid waste standard number	nnn
21-40	Political jurisdiction name	alphanumeric-not right justified

Data Type	Description
MF	Strategy end card. Following the last strategy card, a card with END punched anywhere between columns 41 and 80 must be input.
OF	Area source scale factor cards - one card is input for each area source to be scaled, A maximum of 500 area sources may be scaled. The factor input will be applied in place of the value given by ASFAC. If any scale factor cards are input, scale factor end card described next must also be input. Each scale factor card contains the following data.

Columns	Description	Format (Right Justified)
1-3	Region number	nnn
4-7	SIC number	nnnn
8-11	Site number	nnn

TABLE 7.9-1

PUNCHED CARD INPUTS FOR THE REGIONAL STRATEGIES PROGRAM (Continued)

Data Type	Description

Columns	Description	Format (Right Justified)
12	Process number	n
13 - 19	SO_2 scale factor	+nnn.nn
20 - 26	Particulate scale factor	+nnn.nn

Data Type	Description
OF	Area source scale factor end card. Following the last scale factor card, a card with END punched anywhere between columns 41 and 80 must be input.
OF	Projection factor cards - one card is input for each source (point and area) for which a projection is desired. Point source projections are applied to allowable emission values and area source projections are applied to the scaled area source emission values. If any projection cards are input, the projection end card, described next, must be input after the projection cards. Each projection card contains the following data:

Columns	Description	Format (Right Justified)
1-3	Region number	nnn
4-7	SIC number	nnnn
8-10	Site number*	nnn
11-12	Process number*	nn
13-24	SO_2 projection factor	+nnnnnnnn.nn
25-36	Particulate projection factor	+nnnnnnnn.nn

Data Type	Description
OF	Projection end card - following the last projection card, a card with END punched anywhere between columns 41 and 80 must be input.

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*For area sources, Site number is nnnn and Process number is n.

TABLE 8-2

AIR POLLUTANT CONCENTRATION PROGRAM MESSAGES

Manual Reference Number	Message Content	Message Significance
A1	NOT STATISTICALLY SIGNIFICANT	The theoretical value (5 percent confidence level) expected for the correlation coefficient is shown. If the calculated correlation coefficient is less than or equal to the 5 percent value, the following note is printed in the output table; "NOT STATISTICALLY SIGNIFICANT." When this occurs, the air quality values at receptors will be printed without the use of these regression constants. It should also be noted that in this case the constants should not be input using the SO2CAL= and PARCAL= cards (Section 7.3.3); instead, the reason for the poor correlation should be determined and the necessary corrections made.
A2	STATISTICALLY SIGNIFICANT	This is the opposite circumstance to A1 above. In this case, the calculated coefficient is greater than the 5 percent confidence level.
AC01	DPHNX, WNDFRQ, TA, PA MUST BE ALL NON-ZERO--RUN TERMINATED	The user must input non-zero values for the mixing height, wind frequency, ambient temperature and ambient pressure.
AC02	IREG NOT EQUAL TO 0, 1, OR 2--RUN TERMINATED	IREG contains an invalid input that will cause the program to dump.
AC03	IMPROPER RECEPTOR INPUT--RUN TERMINATED	Both the grid system and the non-grid receptors were not included in the card inputs to the program.